NEW CYCLOPOID COPEPODS ASSOCIATED WITH POLYCHAETE ANNELIDS IN MADAGASCAR

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INTRODUCTION

At Nosy Bé, in northwestern Madagascar, copepods are known to be associated with many different marine invertebrates, but as yet none has been described from polychaete annelids. This paper deals with six new cyclopoid copepods collected from polychaetes at Nosy Bé in 1960 and 1963–64.

All collections were made by A. G. Humes, those in 1960 during an expedition of the Academy of Natural Sciences of Philadelphia, and those in 1963–64 as part of the U.S. Program in Biology of the International Indian Ocean Expedition. Type material has been deposited in the large copepod collection of the United States National Museum. Other specimens of the new species (with the exception of *Nasomolgus leptus*) have been placed in the Museum of Comparative Zoology.

The study of the specimens has been aided by a grant (GB-1809) from the National Science Foundation of the United States.

All figures were drawn with the aid of a camera lucida. The letter after the explanation of each figure refers to the scale at which it was drawn.

The abbreviations used are: a_1 = first antenna, a_2 = second antenna, md = mandible, p = paragnath, mx_1 = first maxilla. mx_2 = second maxilla, mxpd = maxilliped, p_1 = leg 1.

We wish to thank Dr. Marian H. Pettibone of the United States National Museum for the identification of the polychaete hosts and to acknowledge with appreciation the assistance to the field work given by the staff of the Centre d'Océanographie et des Pèches at Nosy Bé. We are indebted to Dr. J. P. Harding and Miss P. D. Lofthouse of the British Museum (Natural History) who have examined for us the single type specimen of *Nasomolgus cristatus*.

The copepods described in this paper comprise the following:

1) from *Lepidonotus cristatus* (Grube)
   Cotylomolgus lepidonoti n. gen., n. sp.
2) from *Sabella fusca* (Grube)
   Pseudanthessius ferox n. sp.
3) from *Sabellastarte magnifica* (Shaw)
   Nasomolgus firmus n. sp.
   Nasomolgus leptus n. sp.
   Nasomolgus rudis n. sp.
   Nasomolgus parvulus n. sp.

SYSTEMATIC DESCRIPTION

CLAUSIDIIDAE Embleton, 1901

COTYLOMOLGUS[1] n. gen.

Body cyclopoid, elongated, moderately widened and rather flattened in the pro-

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[1] The generic name is a combination of κοτυλή = a small cup, alluding to the sucker on the second antenna, and μολγός = a sack made of leather.

some. Segment of leg 1 completely fused with the head. Urosome 5-segmented in the female, 6-segmented in the male. Caudal ramus with 6 setae. First antenna 6-segmented. Second antenna 4-segmented, with a large pedunculate sucker on the third segment. Mandible with 4 terminal elements (1 flattened recurved attenuated spine and 3 setae). Paragnath a spinulose lobe. First maxilla a small lobe with 4 elements. Second maxilla probably 2-segmented, with terminally a recurved spine and a long spiniform element. Maxilliped absent in the female, but well formed in the male, where it is 4-segmented (assuming that part of the terminal claw represents the fourth segment).

Legs 1 and 2 with 3-segmented rami. Leg 3 reduced to a single free segment. Leg 4 absent in both sexes. Leg 5 two-segmented in the female, the first segment with a single seta, the second segment armed with 4 setae, 3 of them long and spiniform, the other short and slender. Leg 5 in the male with a single free segment.

Other features as in the species described below.

Living on polychaete annelids.

Type and only known species: *Cotylomolgus lepidonoti* n. sp.

Gender masculine.

Cotylomolgus lepidonoti[1] n. sp.
Figs. 1–29

Type material.—10 females, 8 males, and 3 immature specimens from 5 *Lepidonotus cristatus* (Grube) under intertidal rocks at Antsakoabe, on the northern shore of Nosy Bé, Madagascar. Collected December 1, 1963. Holotype female, allotype, and 11 paratypes (6 females and 5 males) deposited in the United States National Museum, Washington; the remaining paratypes in the collection of A. G. Humes.

Other specimens (all from *Lepidonotus cristatus* collected intertidally at various localities on Nosy Bé).—1 female from 1 host, Ambatoloaka, September 2, 1960; 7 females and 6 males from 2 hosts, Antsakoabe, November 1, 1963; 6 females, 4 males, and 2 immature from 2 hosts, Navetsy, November 3, 1963; 2 females and 3 males from 4 hosts, Antsakoabe, February 16, 1964; 4 females and 4 males from 2 hosts, Antsakoabe, September 7, 1964; and 1 female and 1 male from 1 host, Befifika, October 7, 1964.

Female.—The body (Figs. 1 and 2), with a moderately broadened and somewhat flattened prosome, has a length (excluding the setae on the caudal rami) of 1.41 mm (1.29–1.50 mm) and a greatest width of 0.63 mm (0.59–0.72 mm), based on 8 specimens. The ratio of length to width of the prosome is 1.35 : 1. The segment of leg 1 is completely fused with the head. The epimeral areas of the metasomal segments are rounded posteriorly. These segments are separated by faintly striated intersegmental membranes.

The segment of leg 5 (Figs. 3 and 4) is wider than long, 101 × 257 μ, and bears the fifth legs ventrally on the posterolateral areas. Dorsally the segment bears posteriorly a transverse striated membrane, and ventrally between the insertions of the legs there are 2 patches of spinules arranged in somewhat irregular rows. The genital segment is wider than long, 141 × 177 μ in greatest dimensions, with the broadened anterior two-thirds separated abruptly from the narrowed posterior third (where the width is 130 μ). The posterior margin of the segment bears a striated membrane dorsally and ventrally and has delicate spinules laterally. The areas of attachment of the egg sacs are situated dorsolaterally in the middle of the segment. Each area (Fig. 5) bears 2 small setae about 7 μ in length and a small setiform projection. There are 3 postgenital segments, the first 2 bearing a posterior membrane dorsally and ventrally and lateral spinules as on the genital segment (though the membrane on the second postgenital segment is incomplete midventrally and is indented mid-

[1] The specific name *lepidonoti* is derived from the generic name of the host.

dorsally). The first postgenital segment is 75 × 120 μ, the second 49 × 114 μ, and the third 60 μ (greatest length) × 101 μ. The anal segment, on which the caudal rami are inserted dorsally, bears ventrally near the base of each ramus a patch of very small spinules.

The caudal ramus (Fig. 6) is elongated, 78 μ in length along its outer edge (70 μ along the inner edge) and 33 μ in width, or about 2.4 times longer than wide. The outer lateral seta is 45 μ long and naked. The pedicellate dorsal seta is 36 μ and naked. The outermost terminal seta (86 μ) and the innermost terminal seta (66 μ) are minutely spinulose. There is a single well developed long median terminal seta 314 μ in length and naked. From its outer basal area there arises a finely spinulose slender seta 53 μ in length. This seta has no apparent articulation; presumably it represents the outer of the 2 long terminal setae commonly found in poecilostomes which here has fused with the base of the inner long seta. On the proximal half of the dorsal surface of the ramus there are a few small spinules and on the distal ventral surface there is a patch of very small spinules. A small hair arises on the proximal outer margin of the ramus.

The dorsal surface of the prosome and the dorsal and ventral surfaces of the urosome bear scattered minute setules. The ratio of the length of the prosome to that of the urosome is 2 : 1.

The egg sacs are moderately elongated (Fig. 7), 593 × 246 μ, and contain numerous mostly hexagonal eggs about 55–60 μ in diameter.

The rostral area (Fig. 8) is not well developed and consists of a small lobe lying behind the prominent crescentic ridge between the bases of the first antennae.

The first antenna (Fig. 9) is 6-segmented. The lengths of the segments (measured along their posterior margins) are: 36 (30 μ along the anterior margin), 73, 48, 50, 42, and 32 μ respectively. The first segment bears 5 setae (the posteriormost with lateral hairs); the second bears 11 proximal setae and 3 anterodistal setae; the third 6 medioanterior setae, a single medioposterior seta, and 2 distal setae; the fourth 2 setae and one aesthete proximally and 2 setae distally; the fifth 2 setae and one aesthete distally; and the sixth 7 setae and one aesthete. The formula thus is: 5, 14 (11 + 3), 9 (6 + 1 + 2), 4 + 1 aesthete (2 and 1 aesthete + 2), 2 + 1 aesthete, and 7 + 1 aesthete. All the setae are delicately annulated and naked except for the single haired seta on segment 1.

The second antenna (Figs. 10 and 11) is 4-segmented and distinctly flexed, with the 3 short distal segments directed back toward the relatively elongated proximal segment. The first segment bears anterodistally a cluster of hairs. The second segment bears a row of spinules. The third segment bears a hyaline seta, a spine with its distal third formed like a crooked thumb and spinulose, and a large pedunculate sucker 56 μ in diameter, its cup having well sclerotized supporting rays and with its rim formed by a hyaline lamella ornamented with minute hairlike processes (spinules?). The fourth segment is longer and more slender than the preceding 2 and bears 2 setae on a subterminal expansion and 4 terminal setae, all of them annulated and naked.

The labrum (Fig. 12), held erect in alcoholized specimens, is linguiform in outline, with a small terminal indentation and 2 lateral hyaline lobes.

The mandible (Fig. 13) is a single elongated segment bearing 4 terminal elements: a recurved attenuated flattened spine with a few short lateral spinules, and 3 setae with lateral spinules. The paragnath (Fig. 14) is a rounded lobe bearing slender spinules and showing small circular markings in its cuticle. The first maxilla (Fig. 15) is a small segment armed with 4 elements: 1 seta on the anterior surface, and 3 terminal setae (2 large, the longer 33 μ in length, and 1 shorter and slender). Near the base of the seta on the anterior surface

there is a group of surficial markings. The second maxilla (Figs. 16 and 17) probably consists of 2 segments, though the segmentation is obscure. The proximal portion (first segment?) bears a large ventral patch of small spinules arranged in irregular rows. The distal portion (second segment?) has surficial creases and folds, and bears 2 terminal elements: a greatly recurved spine having on its concave surface 2 relatively long hyaline spinules followed by 2 rows of minute spinules, and a long attenuated spiniform element not clearly articulated with the segment and bearing surficial punctations and a minute subterminal process. The maxilliped is absent.

The postoral area (Fig. 18) shows a number of sclerotized regions, with a transverse lobed area just posterior to the level of the second maxillae having a pair of irregular somewhat spherical sclerotizations. These 2 sclerotized pieces might be considered as remnants of maxillipeds, but since they are so far removed (see Fig. 8) from the usual position of maxillipeds in other poecilostomes they probably do not represent appendages. Posterior to the region shown in Figure 18 there is a balloonlike expansion (see Fig. 2) bearing 2 patches of small spinules arranged in irregular rows (Fig. 19).

As shown in a ventral view of the cephalosome (Fig. 8), the area between the bases of the first antennae is raised to form a crescentic ridge, and bears groups of small spinules. On either side, posterior to the bases of the antennae, the ventral wall of the cephalosome is raised to form a spinulose ridge that extends nearly to the posterolateral corners of the cephalosome. The rostrum and head appendages are thus surrounded by these ridges (except posteriorly). The ridges may aid (together with the 2 suckers on the second antennae) in adhesion to the host.

Legs 1 and 2 (Figs. 20 and 21) have 3-segmented rami. Leg 3 is reduced to a single segment. Leg 4 is absent. The spine and setal formula is as follows (the Arabic numerals indicating setae, there being no spines on the legs):

P 1	protopod 0-0;	1-0	exp 1-0; 1-1; 1,1,4 end 0-1; 0-1; 4
P 2	protopod 0-0;	1-0	exp 1-0; 1-1; 1,4 end 0-1; 0-1; 4
P 3	reduced, 1-0;	2	
P 4	absent		

Leg 1 (Fig. 20) shows a row of spinules on the outer distal area of the coxa, but there is no inner spine or seta on this segment. The intercoxal plate is broad and its distal edge is ornamented anteriorly and posteriorly with 2 groups of small spinules arranged in irregular rows. The basis has an outer haired seta and is ornamented on its anterior surface with a row of spinules between the insertions of the rami and with 3 or 4 rows of spinules medial to the insertion of the endopod; on the margin of the inner expansion of the basis there is a row of long hairs. The outer margins of the segments of both rami are well ornamented with spinules. Hairs occur along the inner margin of the first segment of the exopod and along the outer margins of the first and third segments of the endopod. The segments of the exopod bear slender annulated outer setae instead of the spines often seen in other poecilostomes. The inner margin of the third segment of the endopod shows an interruption of the sclerotization.

Leg 2 (Fig. 21) is in general similar to leg 1, but the several rows of spinules on the anterior surface of the basis medial to the insertion of the endopod are absent, the outer seta on the basis is smaller and naked, there is only 1 small annulated seta on the third segment of the exopod, and there is no interruption in the sclerotization of the inner margin of the third segment of the endopod.

Leg 3 (Fig. 22) consists of only a single elongated free segment, 58×22 μ, armed with 2 very unequal terminal setae, the inner 94 μ in length and bearing rows of very short spinules on its distal two-thirds, the outer 35 μ long, slender, and naked.

Near the insertions of the 2 setae there is a ventral patch of minute spinules. Close to the insertion of the free segment there is an outer naked seta 52 μ long arising from the body.

No trace could be found of leg 4.

Leg 5 (Fig. 23) is 2-segmented. The first segment is 88×73 μ, and bears an outer naked seta 52 μ long. On the dorsal surface of the segment there is a diagonal line from the base of the seta to the inner distal angle; on the ventral surface there are transverse rows of minute spinules near the distal margin. The second segment is 117 μ along the inner margin and 68 μ along the outer margin to the base of the first seta; its greatest diagonal length in 135 μ and its greatest width is 70 μ. The segment is armed with 2 outer lateral spiniform setae (99 and 112 μ long respectively) and 2 very unequal terminal setae, 1 slender and 55 μ, the other spiniform and 140 μ in length. All 4 setae bear extremely minute lateral spinules and are delicately annulated. Diagonal rows of minute spinules occur along the distal dorso-inner margin and extend around on the ventral surface to form a patch near the insertion of the innermost long seta. Another patch of minute spinules arranged in diagonal rows may occur (not in all specimens) on the ventral margin just proximal to the first outer seta.

Leg 6 is probably represented by the 2 small setae on the areas of attachment of the egg sacs (see Fig. 5).

The color in life in transmitted light is translucid to slightly opaque, the eye red, the egg sacs opaque gray.

Male.—The form of the body (Fig. 24) resembles that of the female. The length (without the setae on the caudal rami) is 1.06 mm (0.90–1.17 mm) and the greatest width is 0.46 mm (0.39–0.50 mm), based on 10 specimens. The ratio of length to width of the prosome is 1.4 : 1.

The segment of leg 5 (Figs. 25 and 26), measuring 81×172 μ, resembles that of the female. The genital segment is wider than long, 91×143 μ. The 4 postgenital segments are 55×107, 47×97, 33×92, and 40×86 μ from anterior to posterior.

The caudal ramus is like that of the female.

The surfaces of the prosome and urosome bear minute setules as in the opposite sex. The ratio of the length of the prosome to that of the urosome is about 1.8 : 1.

The rostral area, first antenna, second antenna, labrum, mandible, paragnath, first maxilla, and second maxilla resemble those of the female. The maxilliped (Fig. 27) has a rather poorly defined basal segment. The large second segment bears 2 hyaline naked setae on its inner surface and a large patch of small blunt spinules arranged in longitudinal rows on its posterior surface. The third segment is small and unarmed. The fourth segment probably forms part of the short and rather stout terminal claw, which is 54 μ in length (measured along its axis) and bears near its base a slender naked annulated seta and a very small setule. On the concave surface of the claw there is proximally a minute hyaline process and more distally 2 parallel rows of minute denticles.

The postoral area and the cephalosome resemble generally those areas in the female.

Legs 1, 2, and 3 are like those in the female. Leg 4 is absent.

Leg 5 (Fig. 28) has a single free segment and is held against the sides of the genital segment in alcholic specimens (see Fig. 25) rather than diverging as in the female. The free segment is more elongated than in the female, 59×25 μ in greatest dimensions. The 4 setae measure from outer to inner 79, 95, 39, and 127 μ in length. There is a patch of small spinules on the ventral surface near the insertion of the longest seta. The group of spinules seen in the female on the ventral margin proximal to the first outer seta is absent here. The seta arising from the body near the free segment is 55 μ long and naked.

Leg 6 (Fig. 26) consists of a postero-

lateral flap on the ventral surface of the genital segment, ornamented with minute spinules but apparently lacking spines or setae.

The spermatophore (Fig. 29), attached to the female, is elongated, 234 × 68 μ, including the neck.

The color in life in transmitted light resembles that of the female.

Taxonomic position of the genus.—The new genus *Cotylomolgus* appears to be related to *Myzomolgus* Bocquet and Stock, 1957 (Clausidiidae), and to *Catinia* Bocquet and Stock, 1957 (Catiniidae), genera which live on sipunculid worms. As in these two genera, *Cotylomolgus* has the segment of leg 1 fused with the head, the urosome in the female is 5-segmented and in the male 6-segmented, the first antenna is 6-segmented, the second antenna is 4-segmented with a large sucker on the third segment, the first maxilla bears four elements, leg 5 in the female is 2-segmented and in the male has only a single free segment, and the maxilliped in the male is 4-segmented (assuming that the fourth segment forms part of the claw).

Cotylomolgus differs from *Myzomolgus* chiefly in lacking the maxilliped in the female, in the reduction of leg 3 and the absence of leg 4, and in the absence of an inner spine on the basis of leg 1.

The new genus differs from *Catinia* in having a well developed mandible with four terminal elements, in the reduction of leg 3 and the absence of leg 4, and in the absence of an inner spine on the basis of legs 1–3.

Cotylomolgus differs from both *Myzomolgus* and *Catinia* in certain features of legs 1–4, principally, the absence of an inner spine on the basis of legs 1 and 2, the reduction of the outer spines on the exopods of legs 1 and 2 to simple setae, the reduction of leg 3 to a single free segment, and the absence of leg 4.

The nature of the mandible in *Cotylomolgus*, with its four terminal elements, is more like that of *Myzomolgus* than that of *Catinia*. (Gooding, 1963, in an unpublished thesis, after examination of specimens of *Catinia plana* Bocquet and Stock, 1957, has shown that a pair of small, weakly cuticularized mandibles, bent midway almost at a right angle and apparently without major spines or setae, exists in that species.) Since the structure of the mandible in poecilostomes is characteristic within suprageneric groups and thus may be regarded as indicative of phylogenetic relationship, *Cotylomolgus* appears to be closer to *Myzomolgus* than to *Catinia*.

Bocquet and Stock (1957, p. 430) placed their new genus *Myzomolgus* in the Clausidiidae largely on the basis of the structure of the mouthparts, notably the mandible, the antennae, and the well developed thoracic legs. While *Cotylomolgus* shows a reduction of the legs, a feature which is characteristic of many of the genera in the Clausiidae, the form of its mandible is clausidiid rather than clausiid. We are led, therefore, to include provisionally the genus *Cotylomolgus* in the Clausidiidae, recognizing at the same time that there is a close relationship between the Clausidiidae and the Clausiidae and that the two families may actually represent a single category (see Wilson and Illg, 1955, p. 137).

LICHOMOLGIDAE Kossmann, 1877
PSEUDANTHESSIUS Claus, 1889

Pseudanthessius ferox[1] n. sp.
Figs. 30–59

Type material.—14 females, 5 males, and 5 immature specimens from 3 *Sabella fusca* (Grube), in 1 m, at Ambariobe, a small island between Nosy Bé and Nosy Komba, Madagascar. Collected October 4, 1964. Holotype female, allotype, and 14 paratypes (11 females and 3 males) deposited in the United States National Museum, Washington; the remaining paratypes (dissected) in the collection of A. G. Humes.

[1] The specific name *ferox* (from Latin = warlike, savage) alludes to the rather formidable appearance of the labrum.

Other specimens (all from *Sabella fusca*). —1 female and 2 males from 1 host, in 6–8 m, Ambariobe, December 27, 1963; 4 females, 10 males, and 12 immature specimens from 1 host, in 1 m, west of Pte. Mahatsinjo, Nosy Bé, March 27, 1964; and 4 females and 5 males from 1 host, in 2 m, Andraikarebe, Nosy Komba, October 9, 1964 (these specimens placed in the Museum of Comparative Zoology).

Female.—The body (Fig. 30) is rather elongated, with the prosome moderately broadened. The length (not including the setae on the caudal rami) is 1.73 mm (1.63–1.97 mm) and the greatest width is 0.71 mm (0.67–0.75 mm), based on 10 specimens. The ratio of length to width of the prosome is 1.67 : 1. The segment of leg 1 is separated from the head by a dorsal furrow. Near the level of the maxillipeds on each side of the cephalosome there is a slight notch, perhaps indicating the boundary of the maxillipedal segment. The epimeral areas of the metasomal segments are rather pointed posteriorly.

The segment of leg 5 (Fig. 31) is 104 μ long and bears a transverse sclerotized area 153 μ in width. (The exact width of the segment is difficult to determine, since the fifth legs are fused with it.) The genital segment (Figs. 31, 32, and 33) is 224 μ in length. In dorsal view the segment is widened in its anterior two-thirds (180 μ), then narrowed in its posterior third (130 μ). On the ventral surface of the anterior half there are 2 swollen areas, each about 112 × 68 μ. In lateral view these areas protrude conspicuously. These swellings were seen on all females examined. Their size, shape, position, and lack of a neck make it unlikely that they represent spermatophores. The areas of attachment of the egg sacs are located dorsolaterally at the level of the segmental constriction. Each area in dorsal view (Fig. 34) shows a pedicellate naked seta 37 μ long set upon a sclerotized base and 2 spinelike elements, one 22 μ long and naked, the other 14 μ and bearing a subterminal setuliform process. In lateral view (Fig. 35) the armature is more clearly visible. The 3 postgenital segments are 78 × 112, 62 × 95, and 90 × 91 μ from anterior to posterior.

The caudal ramus (Fig. 36) is elongated, 109 × 38 μ, or about 2.9 times longer than wide. The outer lateral seta is 92 μ long, the pedicellate dorsal seta 31 μ, the outermost terminal seta 81 μ, the innermost terminal seta 138 μ, and the 2 median terminal setae 360 μ (outer) and 560 μ (inner). All the setae except the 2 median terminal ones are finely annulated and all are naked except the innermost terminal 1 which bears an inner row of hairs near its base. The dorsal and ventral surfaces of the ramus bear scattered minute setules.

The dorsal surface of the prosome and the dorsal and ventral surfaces of the urosome bear minute setules. The ratio of the length of the prosome to that of the urosome is 1.45 : 1.

The egg sacs are elongated (Fig. 30), in one female measuring 952 × 190 μ, though there is some variation in length in different individuals, and contain numerous eggs, each about 60 μ in diameter.

The rostral area (Fig. 37) is undeveloped and represented by a crescentic line between the bases of the first antennae.

The first antenna (Fig. 38) is 7-segmented, but the third segment has on its ventral surface a small proximal sclerotized area suggesting an intercalary segment. The lengths of the segments (measured along their posterior non-setiferous margins) are: 15 (70 μ along the anterior margin), 75, 33, 51, 47, 33, and 24 μ, respectively. The formula for the armature is 4, 13, 6, 3, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete. All the setae are naked except 1 on segment 5 and 4 on segment 7 which are haired. One of the terminal setae on the last segment is longer (150 μ) and stronger than any of the others.

The second antenna (Fig. 39) is 4-segmented, with the formula 1, 1, 3, and 5 + II. The last segment, about 55 × 39 μ, bears terminally 2 strong unequal claws 72 and

36 μ long, a slender transversely divided seta, and a small seta near the insertion of the smaller claw; subterminally there are 3 setae, 1 short, the other 2 long. All the setae are naked, and those on the last 2 segments are slightly annulated.

The labrum (Fig. 40) has 2 medial rounded and rather hyaline lobes, external to which there are 2 large well sclerotized spikelike processes about 50 μ in length which extend ventrally to the mouthparts. The labrum lacks fine ornamentation.

The mandible (Fig. 41) has a small naked spinelike element on the convex side at the base of the blade. The blade is attenuated distally and bears a striated flange on the convex side and a row of spinules on the concave side. The paragnath (Fig. 40) is probably represented by a small unornamented rather hyaline lobe about 17 μ long located between the base of the mandible and the outer corner of the labrum. The first maxilla (Fig. 42) consists of a single segment armed with 4 setae, all of which are indistinctly articulated. The second maxilla (Fig. 43) is 2-segmented. The first segment is unarmed. The second segment bears the usual armature consisting of a small hyaline basal outer seta, a larger seta on the posterodorsal surface, and a long subterminal spinulose seta, and terminates in a moderately short lash with prominent dentiform spines proximally becoming slender spinules distally. The maxilliped (Fig. 44) has 3 segments: an elongated unarmed basal segment, a rather swollen second segment partially divided by surficial creases and bearing on the inner surface proximally a patch of spinules and distally 2 naked elements (1 spiniform and 1 setiform), and a small slender terminal segment bearing on its inner surface 2 naked elements (1 spiniform and 1 setiform) and terminating in a spiniform process (not articulated).

The postoral area (see Fig. 37) does not protrude ventrally. A sclerotized line connects the bases of the maxillipeds.

Legs 1–4 (Figs. 45, 47, 48, and 49) have 3-segmented rami, with the exception of the endopod of leg 4 which consists of a single segment. The spine and setal formula is as follows (the Arabic numerals representing setae, the Roman numerals spines):

P 1	protopod 0-1;	1-0	exp 1-0; 1-1;	III,I,4
			end 0-1; 0-1;	I,5
P 2	protopod 0-1;	1-0	exp 1-0; 1-1;	III,I,5
			end 0-1; 0-2;	II,I,3
P 3	protopod 0-1;	1-0	exp 1-0; 1-1;	III,I,5
			end 0-1; 0-2;	II,I,2
P 4	protopod 0-1;	1-0	exp 1-0; 1-1;	II,I,5
			end II	

The inner seta on the coxa of legs 1–3 is long and feathered, but in leg 4 this seta is minute (12 μ long) and naked. In the first 3 legs the inner margin of the basis bears a row of hairs, but these hairs are absent in leg 4. In leg 1 (Fig. 45) the outer spines of the exopod have short blunt spinules along one side. Between the rami the basis (as in legs 2 and 3 also) forms a sharply pointed process (Fig. 46). In leg 2 (Fig. 47) the outer spines of the exopod have delicate spinulose lamellae. The terminal spine on the last segment of the endopod is 66 μ long, naked, somewhat irregular, and has a minutely pointed tip. Leg 3 (Fig. 48) is similar to leg 2, except for differences in the spine and setal formula. Leg 4 (Fig. 49) has a less prominent and more rounded process on the basis between the rami. The endopod is 1-segmented, though the restriction of the inner lateral hairs to the proximal portion and the interruption in the sclerotization suggest a division of the segment. The segment measures 115×57 μ in greatest dimensions. The outer margin of the endopod is somewhat irregular and on its distal half there are 3 groups of minute denticles borne on 3 marginal lobes. The 2 terminal spines are 44 μ (inner) and 29 μ (outer) in length. There is an anterior row of minute spinules near the insertions of these spines.

Leg 5 (Fig. 50) does not have a free segment and bears terminally a naked spine 37 μ and a naked seta 56 μ in length,

and dorsally a seta 55 μ long with lateral hairs.

Leg 6 is probably represented by the armature on the area of attachment of the egg sacs (see Figs. 34 and 35).

The color in life in transmitted light is slightly opaque, the eye red, the egg sacs gray.

Male.—The form of the body (Fig. 51) resembles that of the female. The length (not including the setae on the caudal rami) is 1.41 mm (1.28–1.52 mm), and the greatest width is 0.46 mm (0.42–0.50 mm), based on 10 specimens (the allotype, 4 paratypes, and 5 specimens from Andraikarebe collected October 9, 1964). The epimeral areas of the segments of legs 2–4 are more rounded posteriorly than in the female. The ratio of length to width of the prosome is 1.66 : 1.

The segment of leg 5 is smaller than in the female, being only 52 × 96 μ, but otherwise similar. The genital segment (Fig. 52) is longer than wide, 161 × 146 μ, with gently arcuate lateral margins in dorsal view. The 4 postgenital segments are 77 × 90, 73 × 77, 50 × 64, and 64 × 64 μ from anterior to posterior.

The caudal ramus is like that of the female.

The surfaces of the prosome and urosome bear minute setules as in the female. The ratio of the length of the prosome to that of the urosome is about 1.15 : 1.

The rostral area and first antenna are like those in the female. The second antenna also resembles that of the female, but the slender transversely divided seta on the last segment next to the 2 claws is longer and more clawlike (Fig. 53). The labrum, mandible, paragnath, and first maxilla resemble those of the female. The second maxilla (Fig. 54) is much like that of the opposite sex, but the first segment appears to be a little more swollen and the terminal lash is relatively shorter. The maxilliped (Fig. 55) is 4-segmented (assuming that the fourth segment forms part of the claw). The first segment bears a prominent weakly sclerotized digitiform process on its distal inner corner. The second segment bears on its inner surface 2 setae (31 and 19 μ long) and a row of small spinules. The short third segment is unarmed. The slender claw (Fig. 56), 130 μ in length (measured along its axis), bears near its base a posterior seta 28 μ and an anterior seta 11 μ in length. The marginal lamella along the concave surface of the claw shows a minute interruption about midway, perhaps representing the distal boundary of the fourth segment. The tip of the claw has a very narrow lamella.

The postoral area resembles that of the female.

Leg 1 (Fig. 57) shows several differences from that of the female, especially in the endopod. The outer spines on the exopod are more slender and acutely pointed. The last 2 segments of the endopod are almost completely fused, the only evidence of the former articulation between them seen on the anterior surface where a line extends halfway across the ramus at the level of the spinous process. The distal part of the endopod is much modified, terminating in a sclerotized clawlike structure. There is a single short (10 μ) naked outer spine and 4 setae (1 naked, 20 μ long, with a narrow lamella, arising from the convex edge; 1 feathered, 32 μ long, arising on the posterior surface; and 2 feathered, 44 and 48 μ long, arising on the inner side). On the anterior surface between the spine and the first seta there is a sclerotized clawlike projection (for which no articulation could be seen). This projection may perhaps be derived from the outermost seta in the female. Two other small projections are located subterminally on the anterior surface. The presence of the clawlike structures and the curvature of the distal part of the endopod suggest a prehensile function. The formula for the endopod is 0-1; 0-1 . . . I,4.

Legs 2-5 resemble those of the female.

Leg 6 (Fig. 58) consists of a posterolateral flap on the ventral side of the genital

segment, bearing 2 naked setae 27 and 44 μ in length and having a surficial spiniform projection 4.5 μ long.

The spermatophore (Fig. 59), as seen within the body of the male, is elongated, 151 × 62 μ, not including the short neck of 10 μ.

The color in life in transmitted light resembles that of the female.

Comparison with other species in the genus.—Pseudanthessius ferox may be readily distinguished from 13 of the 22 species in the genus listed by Stock, Humes, and Gooding (1963) on the basis of three recognition characters: the two spikelike processes on the labrum in both sexes, the process on the first segment of the male maxilliped, and the clawlike modification of the endopod of leg 1 in the male. These 13 species, which lack one or more of the three characters and thereby differ from *P. ferox*, are: *aestheticus* Stock, Humes, and Gooding, 1963; *assimilis* G. O. Sars, 1917; *deficiens* Stock, Humes, and Gooding, 1963; *latus* Illg, 1950; *liber* (Brady, 1880); *luculentus* Humes and Cressey, 1961; *mucronatus* Gurney, 1927; *nemertophilus* Gallien, 1935; *notabilis* Humes and Cressey, 1961; *pectinifer* Stock, Humes, and Gooding, 1963; *sauvagei* Canu, 1892; *thorelli* (Brady, 1880); and *tortuosus* Stock, Humes, and Gooding, 1963. *Pseudanthessius procurrens* Humes, 1966 from a cidarid echinoid in Madagascar lacks all three of the characters just mentioned and thus is easily separated from *P. ferox*.

Unfortunately, in the remaining 9 species no information is available regarding these three recognition characters, and other features must be used to separate them from *P. ferox*. Of these species, *liber, sensu* Sewell, 1949, has two long elements on the first segment of the first antenna; *dubius* G. O. Sars, 1918, has a 4-segmented urosome in the female; and the remaining 7 species (*concinnus* Thompson and A. Scott, 1903, *gracilis* Claus, 1889, *graciloides* Sewell, 1949, *obscurus* A. Scott, 1909, *spinifer* Lindberg, 1945, *tenuis* Nicholls, 1944, and *weberi* A. Scott, 1909) have slender setiform elements instead of strong claws on the last segment of the second antenna.

In addition to these differences, other features, such as the length to width ratio of the caudal rami, may be useful in separating many of the species from *P. ferox*. None of the known species of *Pseudanthessius* seems to be closely related to the new species from Madagascar.

NASOMOLGUS Sewell, 1949

This genus was established by Sewell on the basis of a new species, *Nasomolgus cristatus*, of which he found only a single female in debris at a depth of 38 m off the South Arabian coast. In describing the four new species which follow, we have been unable to compare at firsthand this type specimen (which is in the British Museum). However, Dr. J. P. Harding and Miss P. D. Lofthouse of the Museum staff have examined the permanent slide of *N. cristatus* and have supplied us with information on several critical points.

Nasomolgus firmus[1] n. sp.
Figs. 60–86

Type material.—28 females and 4 males from one sabellid polychaete, *Sabellastarte magnifica* (Shaw), in 2 m, at Ambariotelo, a small island between Nosy Bé and Nosy Komba, Madagascar. Collected May 15, 1964. Holotype female, allotype, and 20 paratypes (females) deposited in the United States National Museum, Washington; the remaining paratypes in the collection of A. G. Humes.

Other specimens (all from *Sabellastarte magnifica*).—14 females and 3 males from 2 hosts, under intertidal dead coral at Antsakoabe, on the northern shore of Nosy Bé, November 1, 1963 (of this collection 7 females and 2 males placed in the Museum of Comparative Zoology); 5 females and 3 males from one host, under intertidal rock at Antsakoabe, September 7, 1964.

[1] The specific name *firmus* (from Latin = firm, strong, robust) refers to the strong sclerotization of the body wall and appendages in this species.

Female.—The body (Fig. 60) is moderately broadened with a flattened prosome. The length (without the setae on the caudal rami) is 0.81 mm (0.78–0.84 mm) and the greatest width is 0.36 mm (0.33–0.38 mm), based on 10 specimens. The ratio of length to width of the prosome is 1.46 : 1. The segment of leg 1 is rather indistinctly set off from the head, and its lateral areas are rounded posteriorly. The epimeral areas of the segment of leg 2 are truncated, those of the segment of leg 3 are broadly rounded, and those of the small segment of leg 4 are rather truncated.

The segment of leg 5 (Fig. 61) is rather narrow, 36 × 68 μ, and bears the small fifth legs slightly ventrally a little posterior to the midlateral areas. There is a narrow weakly sclerotized intersegmental sclerite ventrally between the segment of leg 5 and the genital segment. The genital segment is longer than wide, and (as seen in dorsal view) is expanded in its anterior part to form 2 broadly rounded wings but is narrowed posteriorly where its sides are parallel. The length of the segment is 110 μ, the width at the expanded part 100 μ, and the width in the narrow posterior portion 58 μ. The areas of attachment of the egg sacs are situated dorsolaterally on the posterior halves of the expansions. Each area (Fig. 62) bears 2 small naked setae 20 μ and 10 μ in length. There are 3 postgenital segments, without posterior rows of spinules, the first 46 × 48 μ, the second 41 × 43 μ, and the third 44 × 42 μ.

The caudal ramus (Fig. 63) is moderately elongated, 39 μ along its outer edge, 35 μ along its inner edge, and 43 μ in greatest length (including the subconical terminal expansion). Its width proximal to the lateral seta is 18 μ, and distal to that seta 15.5 μ. Taking the greatest dimensions, the ratio of length to width is 2.9 : 1. The outer lateral seta, situated 21 μ from the base of the ramus, is 33 μ long. The pedicellate dorsal seta is 33 μ, the outermost terminal seta 40 μ, and the innermost terminal seta 39 μ. The 2 long median terminal setae, inserted between unornamented dorsal and ventral flaps, are 180 μ (outer) and 325 μ (inner), and do not show the basal "pegs" often seen in lichomolgids. The surfaces of the ramus are without ornamentation except for a setule and a refractile point dorsally.

The dorsal surface of the prosome is ornamented with minute setules and refractile points, and in addition the posterior half of the cephalosome shows dorsally a broad band of extremely fine transverse striations (visible only under very high magnification and not shown in Fig. 60). In dorsal view there are 2 internal longitudinal sclerotized bars (Fig. 60) extending posteriorly from the rostral area to nearly the middle of the cephalosome. (The dorsal surface of the cephalosome in this region is smooth, there being no crest such as Sewell described in *N. cristatus.*) The dorsal and ventral surfaces of the urosome bear relatively few minute setules and refractile points. The ratio of the length of the prosome to that of the urosome is 1.6 : 1.

The body wall (and, as will be seen below, the appendages) is strongly sclerotized, in contrast to the 3 species whose descriptions follow.

The egg sacs are slender (Fig. 64) and reach well beyond the ends of the caudal rami. Each sac is about 418 × 99 μ, and contains numerous eggs about 47 μ in diameter.

The rostral area (Fig. 65) projects slightly in front of the head. Posterior to it, on the ventral surface of the head between the insertions of the second antennae, there is a slight longitudinal ridge.

The first antenna (Fig. 66) is 7-segmented. The lengths of the segments (measured along their posterior non-setiferous margins) are: 13 (35 μ along the anterior edge), 57, 22, 28, 25, 17, and 13 μ respectively. The entire first antenna (without the terminal setae) is about 185 μ long. The formula is: 4, 13, 6, 3, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete.

All the setae are naked. The third segment shows ventrally a sclerotization suggesting an intercalary segment.

The second antenna (Fig. 67) is 4-segmented and rather robust. The first and second segments bear a single small inner seta. The short third segment bears 3 setae, one much larger than the other two. The fourth segment bears 7 elements: 3 proximal slender setae, another more distal slender seta, a slender clawlike seta, and 2 stout recurved claws. All the setae are naked. The entire second antenna is about 108 μ in length.

The labrum (Fig. 65) bears anterolaterally a pair of naked setae, each 44 μ in length, directed ventrally and somewhat anteriorly, and rather indistinctly articulated with the surface of the labrum. Near the extreme anterior end of the labrum, between these 2 setae, there is a somewhat triangular raised sclerotized area (rather similar to that described by Sewell in *N. cristatus*). Posteriorly the labrum is bifurcated to form 2 rounded lobes without ornamentation.

The mandible (Fig. 68) has a moderately elongated blade, with a row of small spinules along the concave outer margin and a fringe of large hyaline spiniform elements along the convex inner margin (the proximal spinelike element in this row being slightly more sclerotized and prominent that the succeeding ones). There are 2 sclerotized spiniform elements on the dorsal surface of the blade. The paragnath (Fig. 69) is a small lobe with hairs along its medial side. The first maxilla (Fig. 70) is a small lobe bearing 4 elements: terminally 2 long unilaterally barbed spines and a minute naked setule, subterminally a shorter naked spine. The second maxilla (Fig. 71) is 2-segmented, the first segment bearing a prominent sclerotized conical projection on its outer margin. The second segment bears proximally 2 slender naked inner setae and a minute outer setule; the segment is prolonged to form a short process bearing a row of about 8 outer spines graduated in length and becoming smaller distally. The maxilliped (Fig. 72) is 3-segmented and slender. The first segment is unarmed. The second segment bears 2 small inner naked setae. The clawlike third segment is very long (110 μ) and slender; proximally on the inner side there is a small naked seta and a minute setule. The distal half of the segment is more slender and less sclerotized than proximally and bears a row of short hairs along each side.

The postoral area (Fig. 65) shows a pair of sclerotizations extending medially from the bases of the maxillipeds, but not joining each other. There is a slightly projecting cordiform area just posterior to the mouth region. The area between the maxillipeds and the first pair of legs projects only slightly.

Legs 1–4 (Figs. 73, 74, 75, and 76) have 3-segmented rami except for the endopod of leg 4 which is 2-segmented. The spine and setal formula is as follows (the Roman numerals indicating spines, the Arabic numerals setae):

P 1	protopod 0-1; 1-0	exp	I-0; 1-1;	III,I,4
		end	0-1; 0-1;	I,5
P 2	protopod 0-1; 1-0	exp	I-0; I-1;	III,I,5
		end	0-1; 0-2;	I,II,3
P 3	protopod 0-1; 1-0	exp	I-0; I-1;	II,I,5
		end	0-1; 0-2;	II,2
P 4	protopod 0-1; 1-0	exp	I-0; 1-1;	II,I,5
		end	0-1; 2	

The inner seta on the coxa of legs 1–3 is long and feathered, but in leg 4 this seta is shorter (20 μ) and naked. A row of hairs occurs on the inner margin of the basis in all 4 legs. The spines on the exopods are recurved posteriorly, with the lateral fringe along their proximal sides more prominent than that on their distal margins. The outer spines on the exopod of leg 1 show small subterminal flagella; the terminal spine on this ramus has a straight tip, while in legs 2–4 the tip is reflexed. The outer spine on the last segment of the endopod of leg 1 is 7 μ in length. The endopod of leg 4 is elongated (Fig. 76). The first segment is 18×11 μ, having a row of hairs on the outer margin and bearing a long feathered

inner distal seta 68 μ in length. The second segment measures 39×8 μ, having a row of hairs on both outer and inner margins and bearing 2 unequal terminal naked setae, the outer one 31 μ, the inner one 50 μ in length. In addition, there is an anterior row of minute spinules on the end of the segment near the insertions of the 2 setae.

Leg 5 (Fig. 77) has a very small quadrate free segment, 6×6 μ, bearing 2 terminal naked setae, the anterior 1 slender and 28 μ long, the posterior 1 much stouter and 44 μ long. The seta arising from the body wall adjacent to the segment is naked and 26 μ long.

Leg 6 is probably represented by the 2 setae near the attachment of the egg sacs (see Fig. 62).

The color in life in transmitted light is slightly opaque, the eye red, the egg sacs gray.

Male.—The body (Fig. 78) is more slender than in the female. The length (excluding the setae on the caudal rami) is 0.58 mm (0.52–0.63 mm) and the greatest width is 0.16 mm (0.14–0.18 mm), based on 10 specimens (the allotype, 3 paratypes, 3 specimens collected at Antsakoabe on November 1, 1963, and 3 collected at the same locality on September 7, 1964). The ratio of length to width of the prosome is 1.8 : 1. The segment of leg 1 is more distinctly separated from the head than in the female.

The segment of leg 5 (Fig. 79), 37×29 μ, resembles that of the female. The ventral intersegmental sclerite between the segment of leg 5 and the genital segment is not evident. The genital segment is longer than wide, 97×75 μ, with its lateral borders in dorsal view only slightly rounded. The 4 postgenital segments are 24×37, 29×34, 23×31, and 25×30 μ from anterior to posterior.

The caudal ramus (Fig. 80) resembles that of the female, but is relatively shorter, the greatest dimensions being 27×13 μ, or 2 times longer than wide. The 2 long terminal setae show basal "pegs."

The surfaces of the prosome and urosome bear scattered hairs and refractile points. The fine transverse striations seen on the dorsal posterior half of the cephalosome in the female are absent here. The ratio of the length of the prosome to that of the urosome is 1.25 : 1.

The rostral area and first antenna resemble those of the female. The second antenna (Fig. 81) is a little more slender than in the female. The first and second segments bear a small seta as in the female, but, in addition, the second segment is ornamented on its inner surface with 2 rows of minute spinules. The third segment bears 4 setae, 3 of them slender, the other larger and placed more distally, very near the base of the fourth segment. The fourth segment bears 7 elements: 3 slender outer setae, 2 setae near the bases of the claws, and 2 recurved claws, 1 slender, the other stout. The labrum, mandible, paragnath, and first maxilla resemble those of the female. The second maxilla (Fig. 82) has on the outer margin of its first segment groups of small spinules and a small process which is perhaps homologous to the prominent conical projection seen in the female. The maxilliped (Fig. 83) is slender and 4-segmented (assuming that the fourth segment forms part of the claw). The first segment shows on its inner edge a small knob and a rather pointed sclerotized process. The second segment has 2 small inner naked setae and 2 inner rows of small spinules. The small third segment is unarmed. The recurved claw, 58 μ in length (measured along its axis), bears proximally a posteromedial, minutely barbed seta 20 μ long and on its inner edge a slender naked setule 6 μ long and a small process. The posteroinner surface of the claw is covered with minute blunt spinules. At the tip of the claw there is a conspicuous lamella.

The postoral area resembles that of the female.

Legs 1–4 in general resemble those of

the female, having the same spine and setal formula. The outer distal corners of the first 2 segments of the endopods in legs 1–3 bear small spinelike processes not present in the female. The outer spine on the last segment of the endopod of leg 1 (Fig. 84) is 11 μ in length, a little longer than in the female.

Leg 5 is like that of the female.

Leg 6 (Fig. 85) consists of a posterolateral flap on the ventral surface of the genital segment, bearing 2 naked setae 17 and 28 μ long.

In 2 females spermatophores (Fig. 86) were attached in pairs. In both cases the 2 elongated spermatophores (86 × 31 μ without the neck) were joined in a common tube which led into the genital segment.

The color in life in transmitted light resembles that of the female.

Comparison with Nasomolgus cristatus.—*Nasomolgus firmus* seems to be close to *N. cristatus*, but shows several differences. In *N. firmus* the caudal ramus is a little longer (with a ratio of length to width of 2.9 : 1 instead of about 2.5 : 1), the lateral seta on the ramus is inserted halfway along the margin instead of at about the junction of the middle and distal thirds as in Sewell's species, the formula for the last segment of the endopod of leg 3 is II,2 instead of I,II,2, the two setae on the end of the last segment of the endopod of leg 4 have a ratio of 1 : 1.6 instead of about 1 : 2.2 as in Sewell's fig. 35E, and the outline of the genital segment in dorsal view is slightly different.

In both *N. cristatus* and *N. firmus* the labrum bears anteriorly a pair of prominent ventrally directed setae, there is a somewhat triangular sclerotized raised area near the front of the labrum at the posterior end of the rostral area, the maxilliped is 3-segmented with the last segment very long and slender, and the arrangement of the spines on the last segment of the exopod of leg 1 is III,I instead of II,I as in Sewell's formula (p. 125). Since it has been impossible to dissect the single type specimen of *N. cristatus*, the mouthparts cannot be compared in detail.

Nasomolgus leptus[1] n. sp.
Figs. 87–109

Type material.—4 females and 4 males from 2 *Sabellastarte magnifica* (Shaw), under intertidal dead coral at Antsakoabe, on the northern shore of Nosy Bé, Madagascar. Collected November 1, 1963. Holotype female, allotype, and 4 paratypes (2 females and 2 males) deposited in the United States National Museum, Washington; the remaining paratypes (both dissected) in the collection of A. G. Humes. (This species was collected in company with *N. firmus*, from the same 2 polychaetes.)

Female.—The body (Fig. 87) is elongated and rather slender, with the prosome not broadened and not as flattened as in the previous species. The length (not including the setae on the caudal rami) is 1.40 mm (1.37–1.44 mm) and the greatest width is 0.35 mm (0.31–0.39 mm), based on 4 specimens. The ratio of length to width of the prosome is 1.8 : 1. The segment of leg 1 is distinctly separated from the head. The epimeral areas of the metasomal segments resemble fairly closely those in the previous species.

The segment of leg 5 (Fig. 88) is 60 × 94 μ, with the small fifth legs borne as in *N. firmus*. A weakly developed intersegmental sclerite occurs ventrally between the segment of leg 5 and the genital segment. The genital segment is longer than wide, in dorsal view being broadly expanded laterally in its anterior half and constricted in its posterior half. The length of the segment is 174 μ, the width at the expansions 140 μ, and the width in the posterior part of the constricted area 73 μ (at this level the segment being slightly wider than more anteriorly). The areas of attachment of the egg sacs are placed

[1] The specific name *leptus* (from λεπτός = thin, slender) refers to the elongated slender form of the body in this species.

dorsolaterally on the posterior halves of the expansions. Each area (Fig. 89) carries 2 naked setae, 11 and 24 μ in length. The 3 postgenital segments, without posterior rows of spinules, are 96×60, 82×52, and 96×55 μ (the last segment being slightly expanded laterally in its posterior half where the width was measured).

The caudal ramus (Fig. 90) is very elongated and slender, 278 μ in length, 25 μ wide in its basal part and 19 μ wide at the level of the outer lateral seta. Taking the latter width, the ratio of length to width is 14.6 : 1. The outer lateral seta, located 177 μ from the base of the ramus, is 36 μ long. The pedicellate dorsal seta is 26 μ, the outermost terminal seta 40 μ, the innermost terminal seta 36 μ, and the 2 long median terminal setae are 143 μ (outer) and 260 μ (inner) and show weak basal "pegs." All the setae are naked. A minute setule 3 μ long occurs on the outer proximal margin of the ramus. The ramus is ornamented with a few minute hairs.

The dorsal surface of the prosome bears very few hairs and no refractile points. The dorsal and ventral surfaces of the urosome are very sparsely ornamented with hairs and refractile points. The urosome is longer than the prosome, the ratio being 1.2 : 1.

The egg sacs (Fig. 87) are elongated and slightly arcuate, reaching beyond the tips of the long caudal rami. Each sac is about 759×198 μ, and contains many eggs approximately 57 μ in diameter.

The rostral area (Fig. 91) does not project forward as in the previous species. Between the rostrum and the labrum there is a low longitudinal ridge (between the bases of the second antennae).

The first antenna (Fig. 92) is 7-segmented, the lengths of the segments (measured along their posterior non-setiferous margins) being: 18 (44 μ along the anterior margin), 94, 35, 45, 31, 18, and 14 μ respectively. The formula for the setae and aesthetes is the same as in *N. firmus*. All the setae are naked.

The second antenna (Fig. 93) is 4-segmented and fairly robust. Each of the first 2 segments bears a short distal inner seta with lamellate margins. The third segment bears 2 such setae plus a longer seta. The fourth segment carries 7 elements (including 2 stout recurved claws) much like those of *N. firmus*.

The labrum (Figs. 91 and 94) bears anterolaterally, as in the previous species, a pair of ventrally directed naked setae, each 55 μ in length. There is no triangular sclerotized area in front of the labrum, such as seen in *N. firmus*. Posteriorly, the edge of the labrum is deeply bilobed, with each lobe elongated, rounded, and unornamented, and with a short median process between the bases of the lobes.

The mandible (Fig. 95), paragnath, and first maxilla (Fig. 96) resemble those of *N. firmus*. The second maxilla (Fig. 97) is 2-segmented. The first segment has a broad sclerotized bulge on its outer margin and an interrupted crescentic row of spinules on its posterodorsal surface. The second segment is similar to that in the previous species, but the spines on the distal prolongation are more numerous and slender. The maxilliped is very similar to that of *N. firmus*, having the same general form and armature and with the slender clawlike segment 122 μ long.

The postoral area (Fig. 98) resembles generally that in the previous species and shows a weak line between the bases of the maxillipeds. The ventral surface between the bases of the maxillipeds and the first pair of legs is slightly protuberant.

Legs 1–4 (Figs. 99, 100, 101, and 102) resemble those of *N. firmus*, with the same spine and setal formula except for the endopod of leg 3 where the formula is 0-1; 0-2; I,II,2, the outer marginal spine on the last segment being retained. The terminal spine on the last segment of the exopods of all 4 legs is not reflexed at the tip. The outer spine on the last segment of the endopod of leg 1 is 14 μ in length. The endopod of leg 4 is elongated (Fig. 102). The first segment is 33×19 μ and bears a short

feathered inner distal seta 22 μ long. The second segment is 74×13 μ and bears 2 terminal slightly barbed setae 44 μ (outer) and 77 μ (inner) in length. The ornamentation of the endopod resembles that of *N. firmus*. The inner coxal seta of leg 4 is short (13 μ) and naked.

Leg 5 (Fig. 103) resembles that in the previous species, with the small free segment 7 μ in anterior length, 6 μ in posterior length, and 8 μ in width at the middle.

Leg 6 is probably represented by the 2 setae near the attachment of the egg sacs (see Fig. 89).

The color in life in transmitted light is moderately translucid, the eye red, the egg sacs gray.

Male.—The body (Fig. 104) is more slender than that of the female. The length (excluding the setae on the caudal rami) is 0.94 mm (0.93–0.96 mm) and the greatest width is 0.19 mm (0.18–0.19 mm), based on 4 specimens. The ratio of length to width of the prosome is 2.1 : 1. The segment of leg 1 is less distinctly set off from the head than in the female.

The segment of leg 5, 40×58 μ, resembles that of the female. Ventrally between the segment of leg 5 and the genital segment there is no evident intersegmental sclerite. The genital segment (Fig. 105) is elongated, 151×50 μ, with its sides in dorsal view slightly rounded. The 4 postgenital segments are 57×46, 61×40, 47×34, and 57×33 μ from anterior to posterior.

The caudal ramus (see Fig. 105) is elongated, 135×16 μ, about 8.4 times longer than wide. It is a little less tapered distally than in the female, but bears similar armature.

The dorsal surface of the prosome seems to lack ornamentation. The dorsal and ventral surfaces of the urosome are unornamented except for a pair of hairs on the dorsal surface of the anal segment. As in the female, the urosome is longer than the prosome, the ratio being 1.3 : 1.

The rostral area and first antenna resemble those of the female. The second antenna (Fig. 106) is more slender than in the female. The arrangement of the spines and setae is the same as in the male of *N. firmus*, with 4 elements on the third segment instead of 3 as in the female. The 2 terminal claws are distinctly jointed. The slender clawlike seta on the last segment has a more blunt tip than in the female. The fine ornamentation, not present in the female, consists of a small patch of spinules on the inner proximal surface of the first segment and a long patch of small spinules on the inner surface of the second segment.

The labrum, mandible, paragnath, and first maxilla resemble those of the female. The second maxilla is also similar to that in the opposite sex, but the outer bulge on the first segment is much less prominent. The maxilliped (Fig. 107) resembles in general form that of *N. firmus*. The second segment has on its inner surface 2 small naked setae and 2 rows of spinules. The recurved claw, 68 μ in length (measured along its axis), shows a slight indication of division. Proximally the claw bears a posteromedial barbed seta 19 μ long and an adjacent inner naked setule 6 μ long. The concave surface of the claw bears a row of small spinules, instead of being covered with minute blunt spinules as in *N. firmus*.

The postoral area is similar to that in the previous species.

Legs 1–4 are like those of the female, with the same spine and setal formula. The outer distal spine on the last segment of the endopod of leg 1 is 16.5 μ in length, being slightly longer than in the female.

Leg 5 resembles that of the female.

Leg 6 (Fig. 108) consists of a posterolateral flap on the ventral surface of the genital segment, bearing 2 slender naked setae 26 and 31 μ in length.

The spermatophore (Fig. 109), seen only inside the body of a male, is elongated, 113×49 μ, not including the neck.

The color in life resembles that of the female.

Comparison with other species.—*Nasomolgus leptus* may readily be distinguished

from *N. firmus* and *N. cristatus* by its greater length, by its more slender body form, and by the much more elongated caudal rami. It differs further from *N. firmus* in the nature of the protuberance on the first segment of the second maxilla in the female and in the ornamentation of the claw on the maxilliped in the male.

Nasomolgus rudis[1] n. sp.
Figs. 110–135

Type material.—10 females and 5 males from one *Sabellastarte magnifica* (Shaw), in 2 m, at Ambariotelo, a small island between Nosy Bé and Nosy Komba, Madagascar. Collected May 15, 1964. Holotype female, allotype, and 10 paratypes (8 females and 2 males) deposited in the United States National Museum, Washington; the remaining paratypes (dissected) in the collection of A. G. Humes.

Other specimens (all from *Sabellastarte magnifica*, but one host identification uncertain as indicated below).—10 females and 2 males from 2 hosts, under intertidal dead coral, Antsakoabe, on the northern shore of Nosy Bé, November 1, 1963; 11 females from 1 host (only the plume collected, but probably *S. magnifica*), in 14 m, Tany Kely, a small island south of Nosy Bé, December 23, 1963; 9 females and 1 male from 1 host, under intertidal rock, Antsakoabe, September 7, 1964 (these specimens placed in the Museum of Comparative Zoology); and 4 females from 1 host in 1 m, Ambariobe, near Ambariotelo, October 10, 1960.

Female.—The body (Fig. 110) is broadened in the prosomal region. The length (excluding the setae on the caudal rami) is 0.87 mm (0.77–0.97 mm) and the greatest width is 0.41 mm (0.36–0.46 mm), based on 10 specimens. The ratio of the length to the width of the prosome is 1.45 : 1. The segment of leg 1 is clearly set off from the head. The epimeral areas of the pedigerous segments are shaped much as in *N. leptus*.

The segment of leg 5 (Fig. 111) is 55 × 78 μ, with the fifth legs borne as in the 2 previous species. There is a small intersegmental sclerite ventrally between the segment of leg 5 and the genital segment. The genital segment is a little wider than long and in dorsal view is broadly expanded in its anterior two-thirds and constricted in its posterior third. The length of the segment is 99 μ, the width at the expansions 112 μ, and the width in the posterior part of the constricted area 58 μ. The areas of attachment of the egg sacs are situated dorsolaterally on the posterior halves of the expansions. Each area (Fig. 112) bears 2 naked setae 31 and 11 μ in length, a short inner spinous process, and an outer membranous expansion. The 3 postgenital segments, without posterior rows of spinules, are 32 × 52, 24 × 45, and 33 × 43 μ from anterior to posterior.

The caudal ramus (Fig. 113) is short, 25 μ along its inner margin, 27 μ along its outer margin, and 18 μ wide at the level of the outer lateral seta. The ratio of length to width is 1.44 : 1. The outer lateral seta, located 14 μ from the base of the ramus, is 56 μ long. The pedicellate dorsal seta is 33 μ, the outermost terminal seta 54 μ, the innermost terminal seta 72 μ, and the 2 long median terminal setae are 265 μ (outer) and 407 μ (inner) and are basally "pegged." All the setae are naked. Two minute hairs occur on the dorsal surface of the ramus.

The dorsal surface of the prosome is almost devoid of ornamentation, there being only a few hairs on the metasomal segments. The dorsal and ventral surfaces of the urosome have scattered hairs and refractile points. The prosome is much longer than the urosome, the ratio being 2.53 : 1.

The egg sacs are elongated, extending to the ends of the ramal setae. Each sac (Fig.

[1] The specific name *rudis* (from Latin = unaffected, simple) refers to the relatively uncomplicated external anatomy of this species.

114) is about 462 × 132 μ, with numerous eggs 44–47 μ in diameter.

The rostral area (Fig. 115) resembles generally that of *N. leptus*, and there is a low ridge between the bases of the second antennae as in that species.

The first antenna (Fig. 116) is much like that in *N. leptus*, with the same arrangement of setae and aesthetes. The lengths of the segments (measured along their posterior non-setiferous margins) are: 13 (38 μ along the anterior margin), 68, 26, 34, 27, 17, and 15 μ respectively. All the setae are naked.

The second antenna (Fig. 117) also resembles that of *N. leptus*, but the seta on the first segment is hyaline and lacks the lamellate margins.

The labrum (Figs. 115 and 118) resembles in general form that of the 2 previous species. Each of the 2 anterolateral and ventrally directed setae is 36 μ long and naked. The 2 posterior lobes are unornamented. There is no triangular sclerotized area near the front of the labrum, such as seen in *N. firmus*.

The mandible (Fig. 119), paragnath, and first maxilla (Fig. 120) are similar to those in the 2 previous species. The second maxilla (Fig. 121) resembles in general form that of *N. leptus*. There is a lightly sclerotized bulge on the outer margin of the first segment. Of the several spines on the distal end of the second segment the first spine is somewhat larger than the succeeding ones. The maxilliped (Fig. 122) resembles that in the 2 previous species, the slender terminal segment being 113 μ long.

The postoral area (Fig. 123) resembles that of *N. leptus*.

Legs 1–4 (Figs. 124, 125, 126, and 127) have the same spine and setal formula as in *N. leptus*, and closely resemble that species in their fine ornamentation. The outer spine on the last segment of the endopod of leg 1 is 10 μ long. The 3 spines on the last segment of the endopod of leg 2 are 12, 9, and 9 μ in length from distal to proximal; those on leg 3 are 16, 10, and 11 μ respectively. The inner coxal seta of leg 4 is 15 μ long and naked. The endopod of leg 4 is less elongated (Fig. 127) than in either of the 2 previous species. The first segment is 28 × 14 μ and bears a short feathered inner distal seta 29 μ long. The second segment is 47 × 12 μ and bears 2 terminal slightly barbed setae 32 μ (outer) and 66 μ (inner) in length. The fine ornamentation of the endopod is similar to that in the 2 previous species.

Leg 5 (Fig. 128) resembles that of *N. leptus*, with the segment having similar dimensions.

Leg 6 is probably represented by the 2 setae near the attachment of the egg sacs (see Fig. 112).

The color in life in transmitted light resembles that in the 2 previous species.

Male.—The body (Fig. 129) is much more slender than in the female. The length (excluding the setae on the caudal rami) is 0.52 mm (0.50–0.54 mm) and the greatest width is 0.15 mm (0.14–0.16 mm), based on 8 specimens (the allotype, 4 paratypes, 2 specimens collected at Antsakoabe on November 1, 1963, and one specimen collected at the same locality on September 7, 1964). The ratio of the length to the width of the prosome is 2.2 : 1. The separation between the segment of leg 1 and the head is rather weak.

The segment of leg 4, 28 × 44 μ, resembles that of the female. The ventral intersegmental sclerite between the segment of leg 5 and the genital segment is absent. The genital segment (Fig. 130) is elongated, 90 × 73 μ, with its sides in dorsal view nearly parallel. The 4 postgenital segments are 22 × 35, 22 × 33, 16 × 31, and 19 × 30 μ from anterior to posterior.

The caudal ramus (see Fig. 130) is relatively shorter than in the female. The length along the outer edge is 19 μ, along the inner edge 18 μ, and its width is 14 μ, or about 1.3 times longer than wide.

The dorsal surface of the prosome is unornamented. The dorsal and ventral sur-

faces of the urosome bear a few hairs and refractile points. As in the female, the prosome is longer than the urosome, the ratio being 1.54 : 1.

The rostral area resembles that of the female. The ridge seen between the bases of the second antennae in the female appears to be absent.

The first antenna is like that of the female. The second antenna (Fig. 131) has the same arrangement of spines, setae, and claws as in the preceding 2 species, with 4 elements on the third segment instead of 3 as in the female. The seta on the first segment has lamellate margins. The 2 large claws are distinctly jointed. The fine ornamentation is like that in *N. leptus*.

The labrum resembles that of the female, but the 2 large setae are situated more posteriorly. The mandible, paragnath, and first maxilla resemble those in the female. The second maxilla (Fig. 132) lacks the bulge on the outer margin of the first segment, but instead bears groups of small spinules; the spines along the distal end of the second segment are more numerous than in the opposite sex. The maxilliped (Fig. 133) resembles generally that of *N. leptus*, the recurved claw being 50 μ in length (measured along its axis).

The postoral area is like that of the female.

Legs 1–4 have the same spine and setal formula as in the female. The spines on the rami are somewhat longer and often straighter. The outer spine on the last segment of the endopod of leg 1 is 19 μ long. The 3 spines on the last segment of the endopod of leg 2 are 18, 13, and 9 μ long from distal to proximal; those on the last segment of the endopod of leg 3 are 21, 11, and 10 μ respectively. The second segment of the endopod of leg 4 is relatively a little shorter than in the female, being 31×10 μ.

Leg 5 resembles that of the female.

Leg 6 (Fig. 134) consists of a posterolateral flap on the ventral surface of the genital segment, bearing 2 slender naked setae both 22 μ long.

The spermatophore (Fig. 135), attached to the female, is elongated, 74×32 μ, not including the neck. Spermatophores may be attached singly or in pairs with a common stalk as seen in *N. firmus*.

The color in life resembles that of the female.

Comparison with other species.—*Nasomolgus rudis* may be separated from *N. cristatus*, *N. firmus*, and *N. leptus* by the length of the caudal rami. In addition, it may be distinguished from *N. firmus* in that its body wall is less strongly sclerotized, certain setae on the second antenna have lamellate margins, the first segment of the second maxilla in the female has a broad bulge rather than a prominent conical projection, the formula for the last segment of the endopod in leg 3 is I,II,2 rather than II,2, the inner distal seta on the first segment of the endopod in leg 4 is much shorter, and the ornamentation of the claw of the maxilliped of the male is less extensive. From *N. leptus* it may also be distinguished by the shorter second segment in the endopod of leg 4.

Nasomolgus parvulus[1] n. sp.
Figs. 136–142

Type material.—14 females from one *Sabellastarte magnifica* (Shaw), in 2 m, at Ambariotelo, a small island between Nosy Bé and Nosy Komba, Madagascar. Collected May 15, 1964. Holotype and 12 paratypic females deposited in the United States National Museum, Washington; the remaining paratypes (dissected) in the collection of A. G. Humes.

Other specimens (all from *Sabellastarte magnifica*).—2 females from 2 hosts, under intertidal dead coral, Antsakoabe, on the northern shore of Nosy Bé, November 1, 1963 (these specimens placed in the Museum of Comparative Zoology); 2 females from 1 host, under intertidal rock, Ant-

[1] The specific name *parvulus* (from Latin = very small) alludes to the small size of this species.

sakoabe, September 7, 1964; and 1 female from 1 host, in 1 m, Ambariobe, near Ambariotelo, October 10, 1960.

Female.—The body (Fig. 136) has a broad prosome. The length (not counting the setae on the caudal rami) is 0.57 mm (0.49–0.54 mm) and the greatest width is 0.23 mm (0.20–0.26 mm), based on 10 specimens. The ratio of the length to the width of the prosome is 1.35 : 1. The segment of leg 1 is separated from the head by a dorsal furrow. The epimeral areas of the pedigerous segments resemble those of *N. leptus* and *N. rudis*.

The segment of leg 5 is similar to that in *N. rudis*. Between this segment and the genital segment there is a small ventral intersegmental sclerite. The genital segment (Fig. 137) is a little wider than long and in dorsal view is broadly expanded in its anterior three-fourths and constricted in its posterior fourth. The length of the segment is 72 μ, the width in the expanded portion 83 μ, and the width in the constricted part 52 μ. The dorsolateral areas of attachment of the egg sacs are located a little more anteriorly than in *N. rudis*. Each area (Fig. 138) bears 2 naked setae 29 and 10 μ in length. The 3 postgenital segments, without posterior rows of spinules, are 25×41, 19×33, and 24×31 μ from anterior to posterior.

The caudal ramus (Fig. 139) is almost quadrate, 16×14 μ, the ratio of length to width being 1.14 : 1. The outer lateral seta is 35 μ long, the pedicellate dorsal seta 24 μ, the outermost terminal seta 40 μ, the innermost terminal seta 44 μ, and the 2 long median terminal setae are 133 μ (outer) and 237 μ (inner) and are basally "pegged." All the setae are naked. A minute hair is borne on the dorsal surface of the ramus.

The dorsal surface of the prosome and the dorsal and ventral surfaces of the urosome bear a few hairs. The prosome is longer than the urosome, the ratio being 2.0 : 1.

The egg sacs (see Fig. 136) are moderately elongated, 280×128 μ, and contain fewer eggs than in *N. leptus* or *N. rudis*, each egg being 44–50 μ in diameter.

The rostral area, first antenna, second antenna, labrum, mandible, paragnath, and first maxilla resemble those of *N. rudis*. The second maxilla (Fig. 140) lacks the bulge on the first segment seen in *N. rudis*, and the first spine in the row on the distal part of the second segment is less enlarged than in that species. The maxilliped and postoral area resemble those of *N. rudis*.

Legs 1–4 have the same spine and setal formula as in *N. leptus* and *N. rudis*. The outer distal corner of the first segment of the endopod of legs 1 and 2 lacks a spinous process. In leg 3 such a process is absent on both first and second segments of the endopod. The endopod of leg 4 (Fig. 141) resembles in general form that of *N. rudis*. The first segment is 17×9 μ and bears a short feathered inner distal seta 11 μ long. The second segment is 31×7 μ and carries 2 terminal slightly barbed setae 37 μ (outer) and 10 μ (inner) in length. The relationship between the lengths of these 2 terminal setae is about 4 : 1 rather than about 2 : 1 as in *N. rudis*. The fine ornamentation of the endopod is similar to that in the 3 previous species.

Leg 5 resembles that of *N. rudis*.

Leg 6 is represented by the 2 setae near the attachment of the egg sacs.

The spermatophore (Fig. 142), attached to the female in pairs, is 77×31 μ, not including the neck.

The color in life in transmitted light resembles that of the 3 previous species.

Male.—Unknown.

Comparison with other species.—*Nasomolgus parvulus* may be distinguished from all other species in the genus on the basis of its small size, its almost square caudal ramus, and the two very unequal terminal setae on the second segment of the endopod of leg 4. In addition, it differs from *N. firmus* in having a much more weakly sclerotized body wall, in the relative lengths of the prosome and urosome,

in its stouter egg sac, in the absence of a prominent conical projection on the first segment of the second maxilla, and in the armature of the last segment of the endopod of leg 3. From *N. leptus* it is very easily distinguished by its much less elongated body, in having a shorter egg sac with fewer eggs, and in lacking the sclerotized bulge on the first segment of the second maxilla. It differs furthermore from *N. rudis* in the proportional lengths of the prosome and urosome, in its shorter egg sac with fewer eggs, and in the absence of an outer bulge on the first segment of the second maxilla.

REMARKS ON THE GENUS *NASOMOLGUS*

With the finding of these four new species of *Nasomolgus* living on a sabellid polychaete, it seems probable that members of this genus customarily live in association with annelids. One may conjecture that Sewell's specimen of *N. cristatus*, found in dredged debris, may have been dislodged from a polychaete host, but this is impossible to establish.

More than one species of *Nasomolgus* may live on a single polychaete. In two instances (collections at Ambariotelo, May 15, 1964, and at Antsakoabe, September 7, 1964) *N. firmus*, *N. leptus*, and *N. parvulus* occurred on a single *Sabellastarte magnifica*. In one case (collection at Antsakoabe, November 1, 1963) all four species of *Nasomolgus* were recovered from two hosts.

The exact region of the body where the copepods live is not known. It is possible that each species of copepod occupies a region separate from the others, but such a supposition can only be substantiated by careful observation of undisturbed living hosts.

Since the type species, *N. cristatus*, is now known to possess in common with the four new species from Madagascar certain fundamental characters (i.e., the pair of setae on the anterior part of the labrum, the 3-segmented maxilliped with a long slender last segment, and the number of spines [III,I] on the last segment of the exopod of leg 1) which were inadequately mentioned in Sewell's original description, a revision of the diagnosis of the genus *Nasomolgus* would be desirable. However, in view of the fact that we have been unable to make a firsthand study of the single specimen of *N. cristatus*, we are not attempting such a revision at present. There are certain features (especially the structure of the mouthparts) that would be necessary to clarify before undertaking a definitive revision. For the moment, the characteristics given by Sewell, together with the additions and corrections just mentioned, will serve to characterize the genus.

REFERENCES CITED

Bocquet, C., and J. H. Stock. 1957. Copépodes parasites d'invertébrés des côtes de France. IVa. Le double parasitisme de *Sipunculus nudus* L. par *Myzomolgus stupendus* nov. gen., nov. sp., et *Catinia plana* nov. gen., nov. sp., copépodes cyclopoïdes très remarquables. Koninkl. Nederl. Akad. Wetensch. Amsterdam, Proc., Ser. C, **60**(3): 410–431.

Brady, G. S. 1880. A monograph of the free and semi-parasitic Copepoda of the British Islands. Ray Society, London, **3**: 1–83.

Canu, E. 1892. Les Copépodes du Boulonnais, morphologie, embryologie, taxonomie. Trav. Lab. Zool. Mar. Wimereux-Ambleteuse (Pas-de-Calais), **6**: 1–354.

Claus, C. 1889. Über neue oder wenig bekannte halbparasitische Copepoden, insbesondere der Lichomolgiden- und Ascomyzontiden-Gruppe. Arb. Zool. Inst. Univ. Wien, **8**(3): 327–370.

Gallien, L. 1935. *Pseudanthessius nemertophilus* nov. sp., copépode commensal de *Lineus longissimus* Sowerby. Bull. Soc. Zool. France, **60**: 451–459.

Gooding, R. U. 1963 (unpublished). External morphology and classification of marine poecilostome copepods belonging to the families Clausidiidae, Clausiidae, Nereicolidae, Eunicicolidae, Synaptiphilidae, Catiniidae, Anomopsyllidae, and Echiurophilidae. Ph.D. Thesis, University of Washington, Seattle.

Gurney, R. 1927. Zoological results of the Cambridge expedition to the Suez Canal, 1924. XXXIII. Report on the Crustacea:

Copepoda (littoral and semi-parasitic). Trans. Zool. Soc. London, **22**(4): 451–477.

Humes, A. G. 1966. *Pseudanthessius procurrens* n. sp., a cyclopoid copepod associated with a cidarid echinoid in Madagascar. Breviora, Mus. Comp. Zool., No. 246: 1–14.

Humes, A. G., and R. F. Cressey. 1961. Deux nouvelles espèces de *Pseudanthessius* (Copepoda, Cyclopoida) parasites des oursins à Madagascar. Mém. Inst. Sci. Madagascar, Sér. F, 1959, **3**: 67–82.

Illg, P. 1950. A new copepod, *Pseudanthessius latus* (Cyclopoida: Lichomolgidae) commensal with a marine flatworm. Jour. Washington Acad. Sci., **40**(4): 129–133.

Lindberg, K. 1945. Un nouveau copépode poecilostome de l'Inde de la famille des Lichomolgidae; *Pseudanthessius spinifer*, n. sp. Bull. Soc. Zool. France, **70**: 81–84.

Nicholls, A. G. 1944. Littoral Copepoda from South Australia (II). Calanoida, Cyclopoida, Notodelphyoida, Monstrilloida and Caligoida. Rec. So. Austral. Mus., **8**(1): 1–62.

Sars, G. O. 1917. An account of the Crustacea of Norway with short descriptions and figures of all the species. Vol. 6, Copepoda, Cyclopoida, pts. 11 and 12, Clausidiidae, Lichomolgidae (part), pp. 141–172. Bergen Museum, Bergen.

———. 1918. An account of the Crustacea of Norway with short descriptions and figures of all the species. Vol. 6, Copepoda, Cyclopoida, pts. 13 and 14, Lichomolgidae (concluded), Oncaeidae, Corycaeidae, Ergasilidae, Clausiidae. Eunicicolidae, Supplement, pp. 173–225. Bergen Museum, Bergen.

Scott, A. 1909. The Copepoda of the Siboga Expedition. Part I. Free-swimming, littoral and semi-parasitic Copepoda. Siboga Exped., **29**a: 1–323.

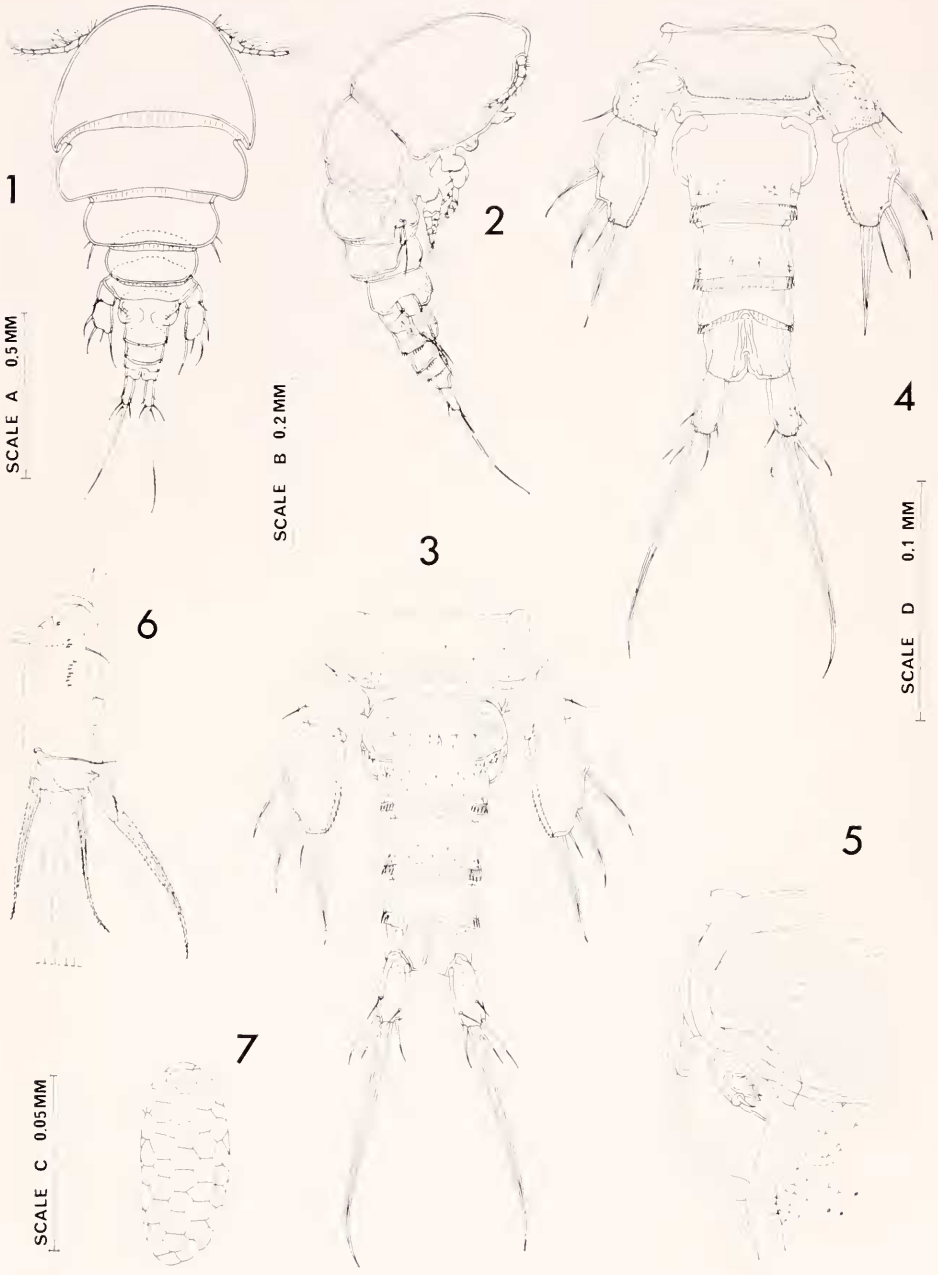
Sewell, R. B. S. 1949. The littoral and semi-parasitic Cyclopoida, the Monstrilloida and Notodelphyoida. John Murray Exped. 1933–34, Sci. Repts., **9**(2): 17–199.

Stock, J. H., A. G. Humes, and R. U. Gooding. 1963. Copepoda associated with West Indian invertebrates IV. The genera *Octopicola, Pseudanthessius* and *Meomicola* (Cyclopoida, Lichomolgidae). Studies Fauna Curaçao and other Caribbean Is., **18**(77): 1–74.

Thompson, I. C., and A. Scott. 1903. Report on the Copepoda collected by Professor Herdman, at Ceylon, in 1902. Rept. Govt. Ceylon Pearl Oyster Fish. Gulf of Manaar, pt. I, Suppl. Rept. No. 7: 227–307.

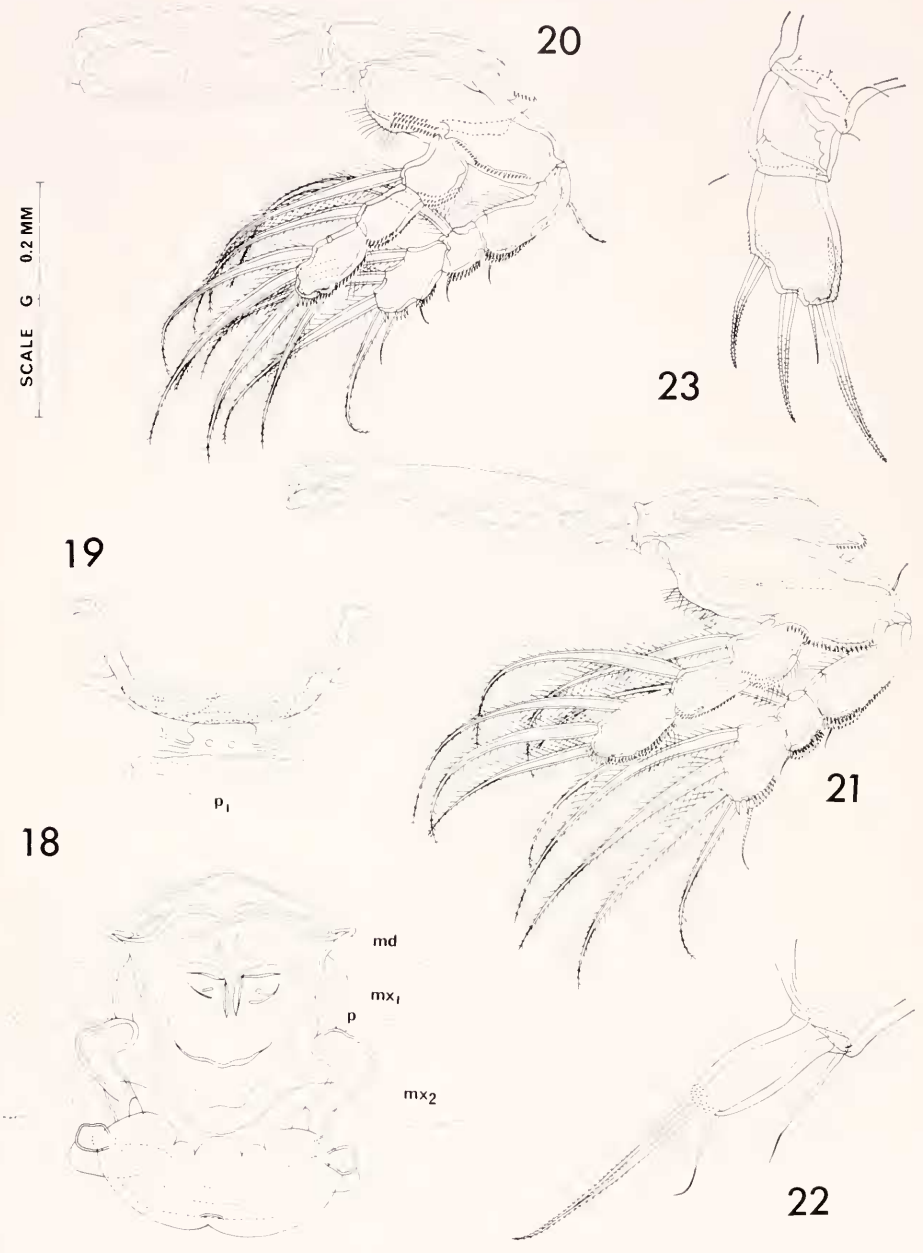
Wilson, M. S., and P. L. Illg. 1955. The family Clausiidae (Copepoda, Cyclopoida). Proc. Biol. Soc. Washington, **68**: 129–142.

(Received December 10, 1965)

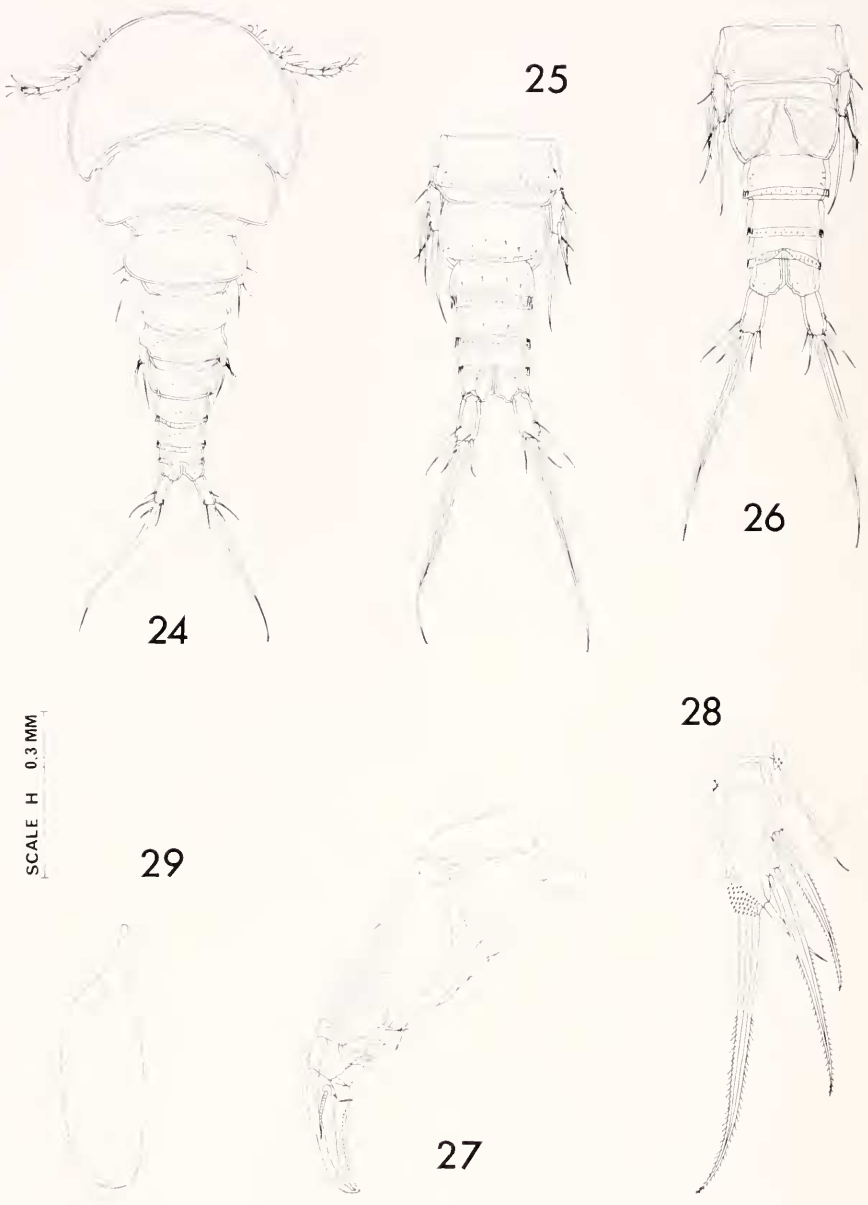


Figures 1–7. *Catylomalgus lepidonati* n. gen., n. sp., female. 1, dorsal (A); 2, lateral (A); 3, urosome, dorsal (B); 4, urosome, ventral (B); 5, area of attachment of egg sac, dorsal (C); 6, caudal ramus, dorsal (D); 7, egg sac, dorsal (A).

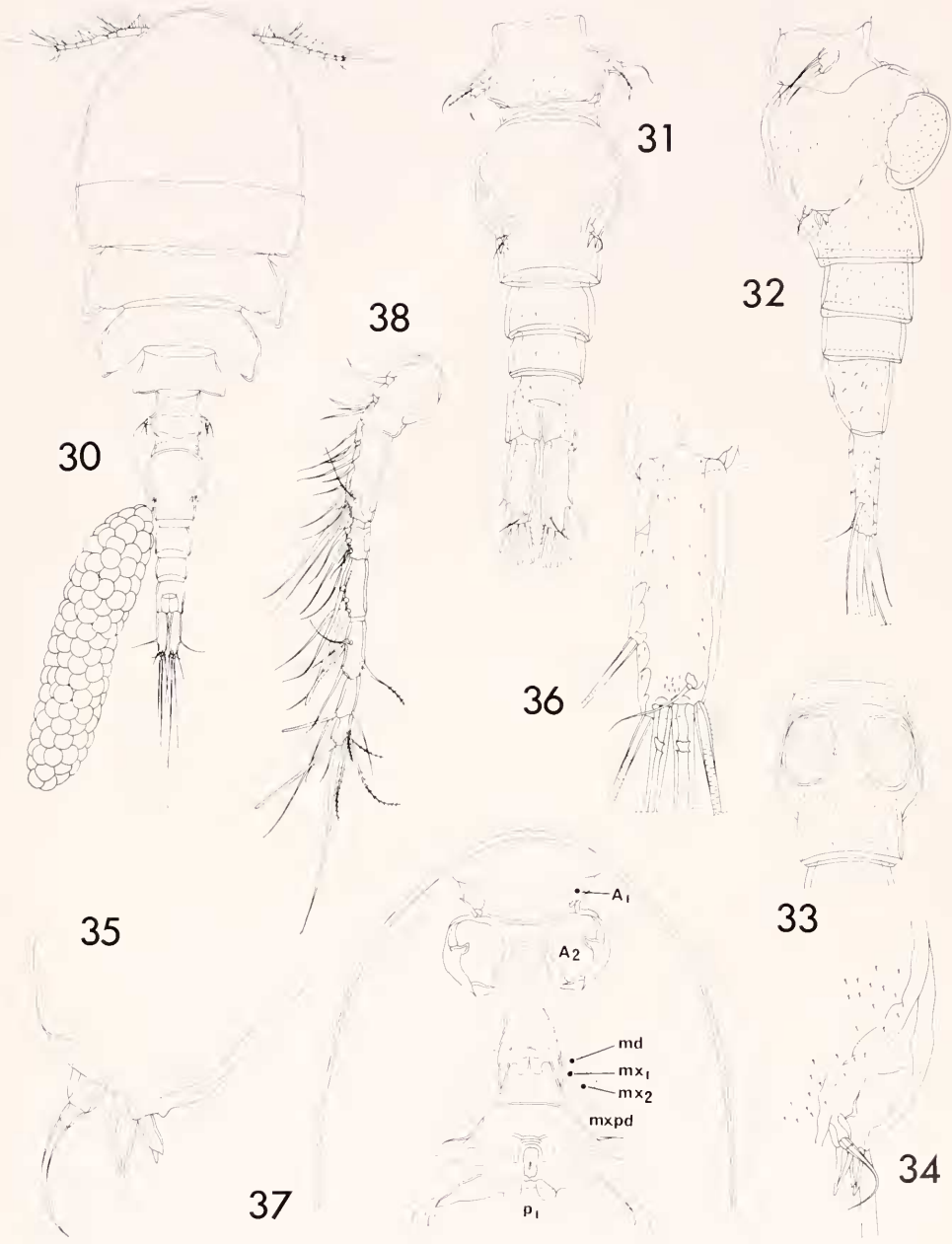
Figures 8–17. *Catylomolgus lepidonati* n. gen., n. sp., female (continued). 8, cephalasome, ventral (B); 9, first antenna, ventral (E); 10, second antenna, anterior (E); 11, secand antenna, posterior (E); 12, labrum, anterior (C); 13, mandible, lateral (F); 14, paragnath, ventral (F); 15, first maxilla, anterior (F); 16, secand maxilla, posterior (E); 17, second maxilla, ventral (E).



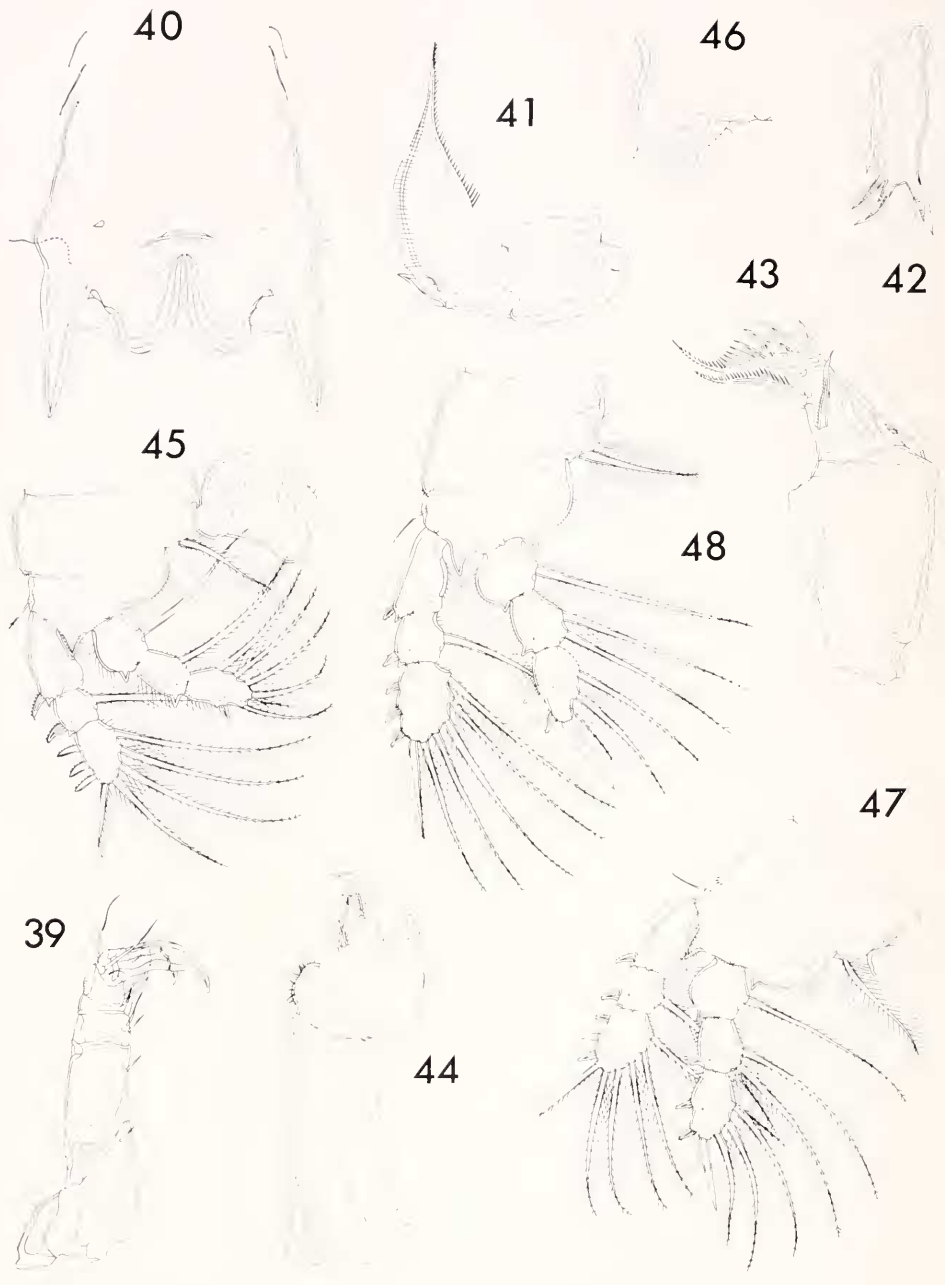
Figures 18–23. *Catylamalgus lepidanati* n. gen., n. sp., female (cantinued). 18, oral area posteriar ta labrum, ventral (C); 19, pastaral pratuberance between maxillipeds and leg 1, ventral (G); 20, leg 1 and intercaxal plate, anteriar (E); 21, leg 2 and intercaxal plate, anteriar (E); 22, leg 3, ventral (D); 23, leg 5, dorsal (G).



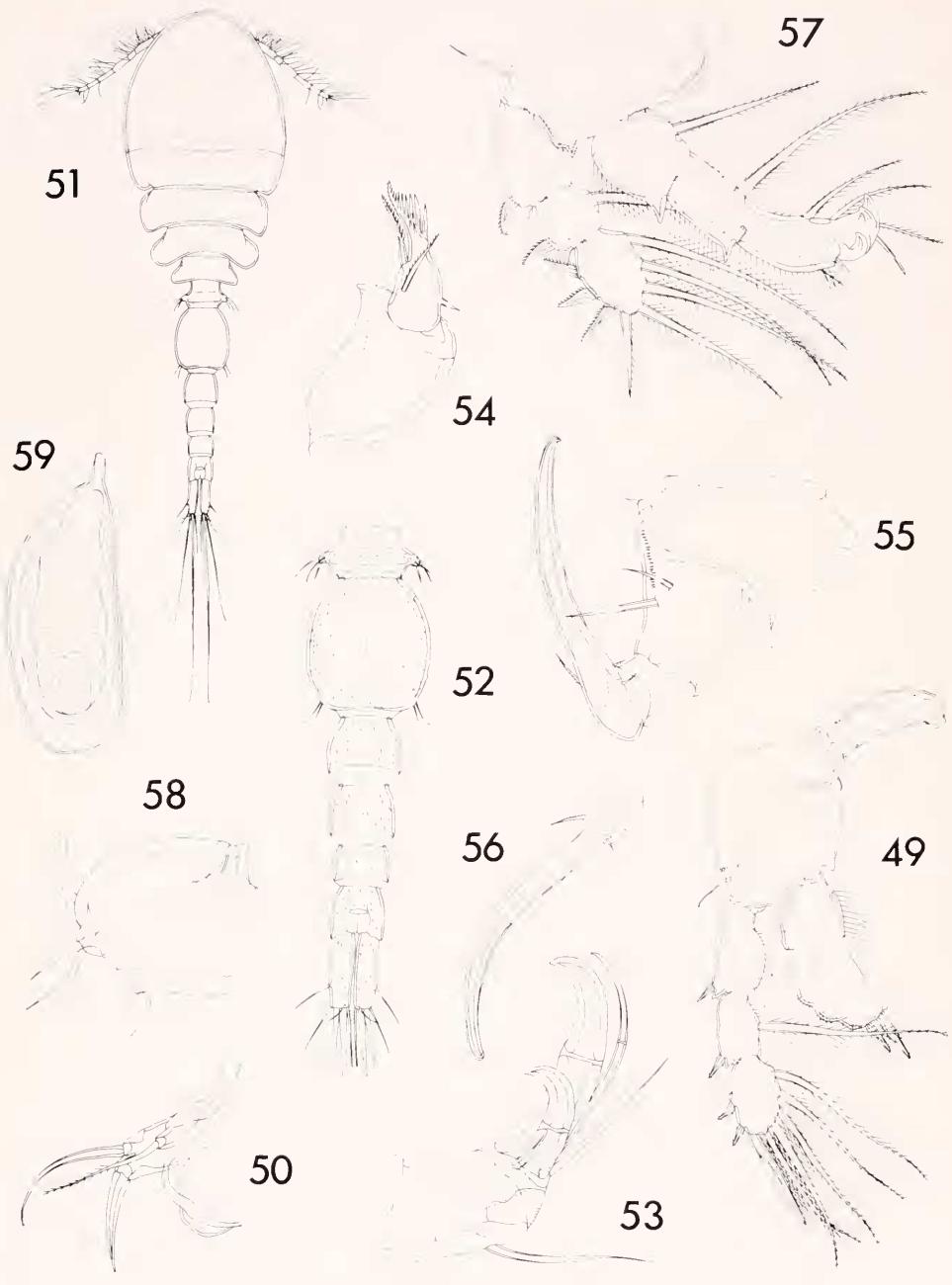
Figures 24–29. *Cotylomolgus lepidonoti* n. gen., n. sp., mole. 24, dorsal (H); 25, urosome, dorsal (B); 26, urosome, ventral (B); 27, maxilliped, posterior (D); 28, leg 5, lateral (D); 29, spermatophore, ventral (G).



Figures 30–38. *Pseudanthessius ferax* n. sp., female. 30, dorsal (A); 31, urosome, dorsal (B); 32, urosome, lateral (B); 33, genital segment, ventral (B); 34, area of attachment of egg sac, dorsal (D); 35, enlargement of setae an egg sac attachment area, lateral (C); 36, caudal ramus, dorsal (D); 37, cephalasome, ventral (H); 38, first antenna, ventral (G).

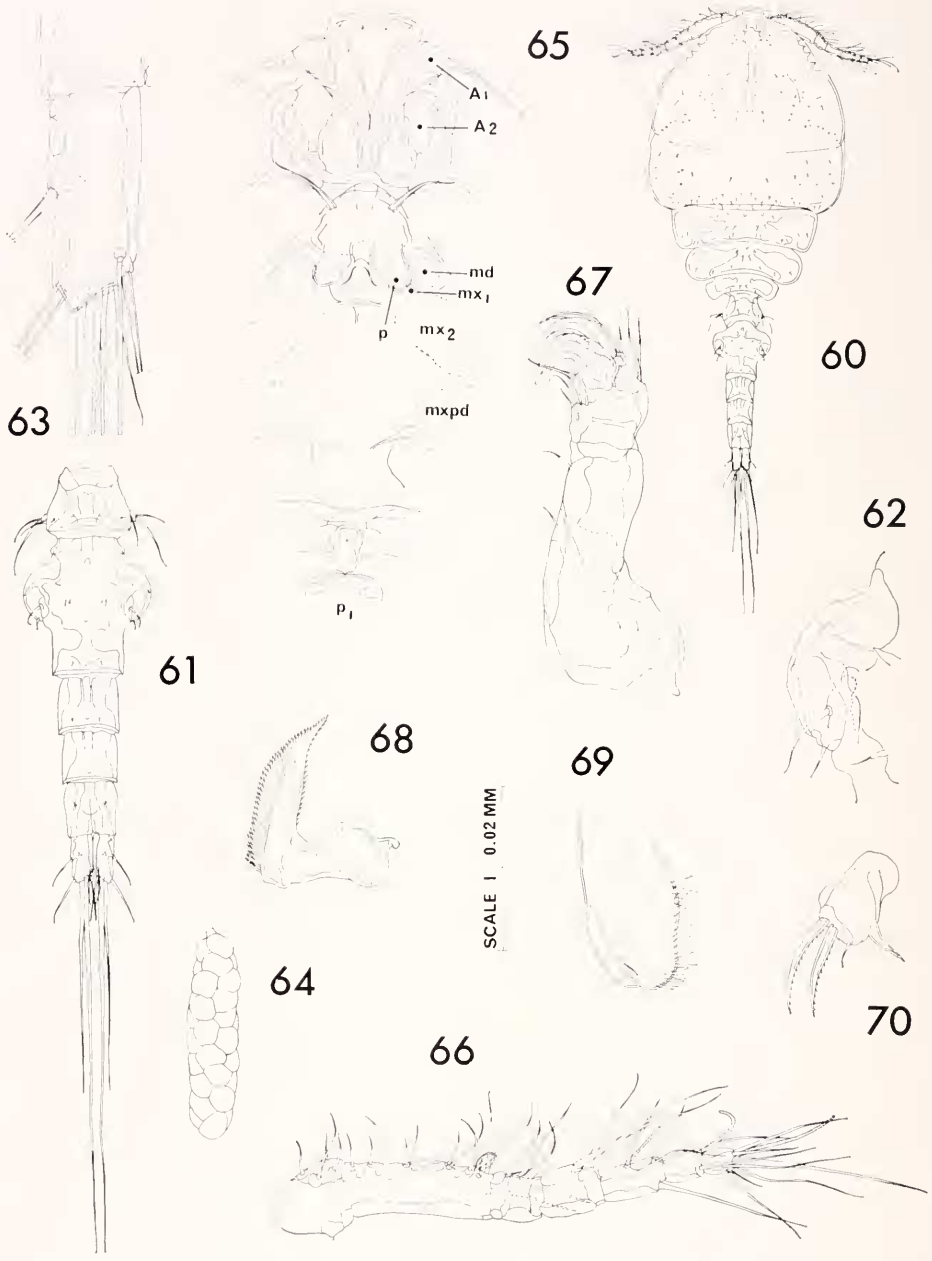


Figures 39–48. *Pseudanthessius ferox* n. sp., female (continued). 39, second antenna, anterior (G); 40, labrum, ventral (D); 41, mandible, anterior (D); 42, first maxilla, anterior (D); 43, second maxilla, posterodorsal (D); 44, maxilliped, anterior (D); 45, leg 1 and intercoxal plate, anterior (G); 46, angular lamella on basis of leg 1, anterior (C); 47, leg 2, anterior (G); 48, leg 3, anterior (G).

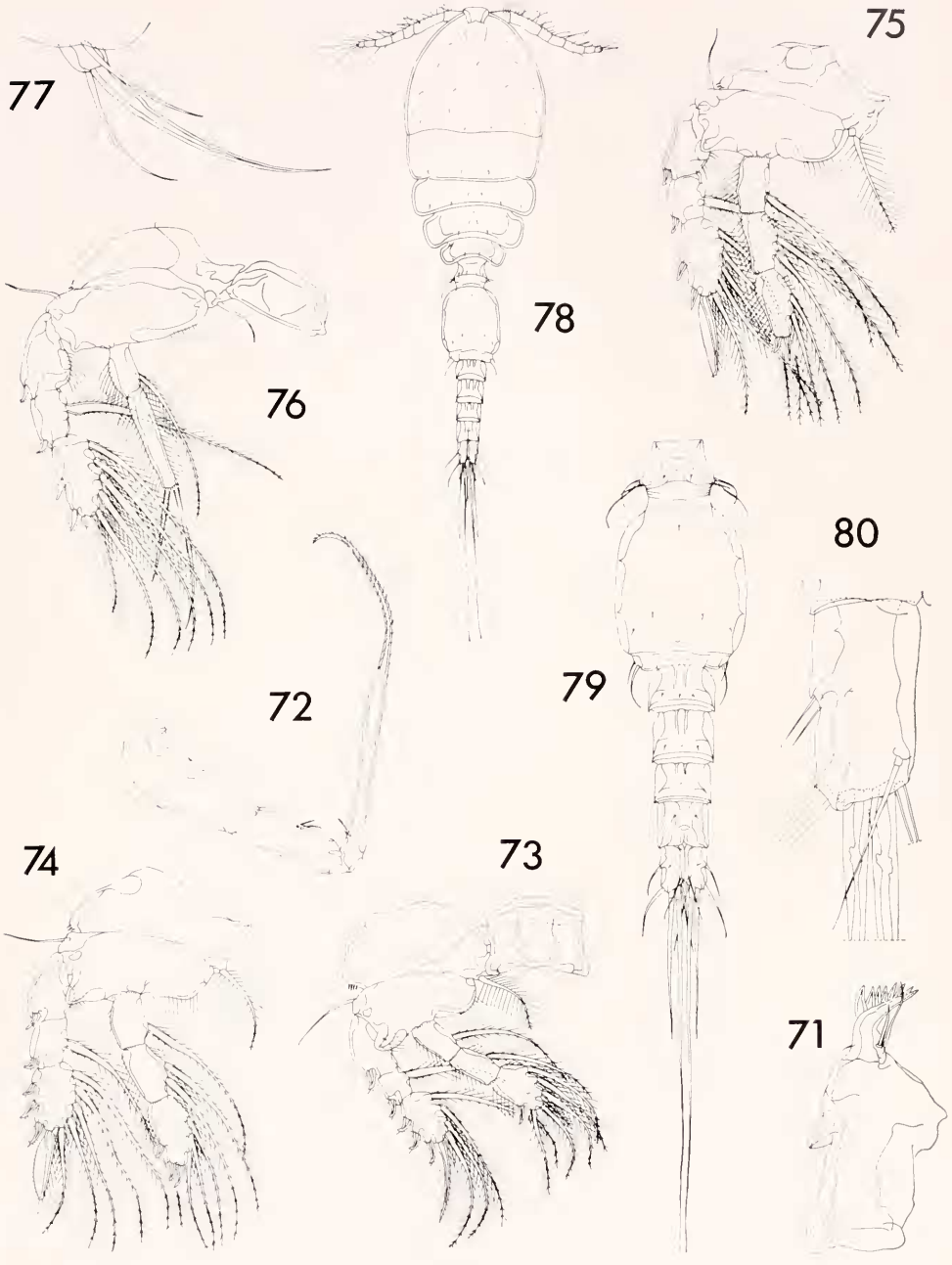


Figures 49–50. *Pseudanthessius ferox* n. sp., female (continued). 49, leg 4 and intercoxal plate, anterior (G); 50, leg 5, dorsal (D).

Figures 51–59. *Pseudanthessius ferox* n. sp., male. 51, dorsal (A); 52, urosome, dorsal (B); 53, last segment of second antenna, posterior (C); 54, second maxilla, posterodorsal (D); 55, maxilliped, anterior or dorsal (D); 56, claw of maxilliped, anterior or dorsal (D); 57, leg 1, anterior (D); 58, leg 6, ventral (D); 59, spermatophore inside male, ventral (E).

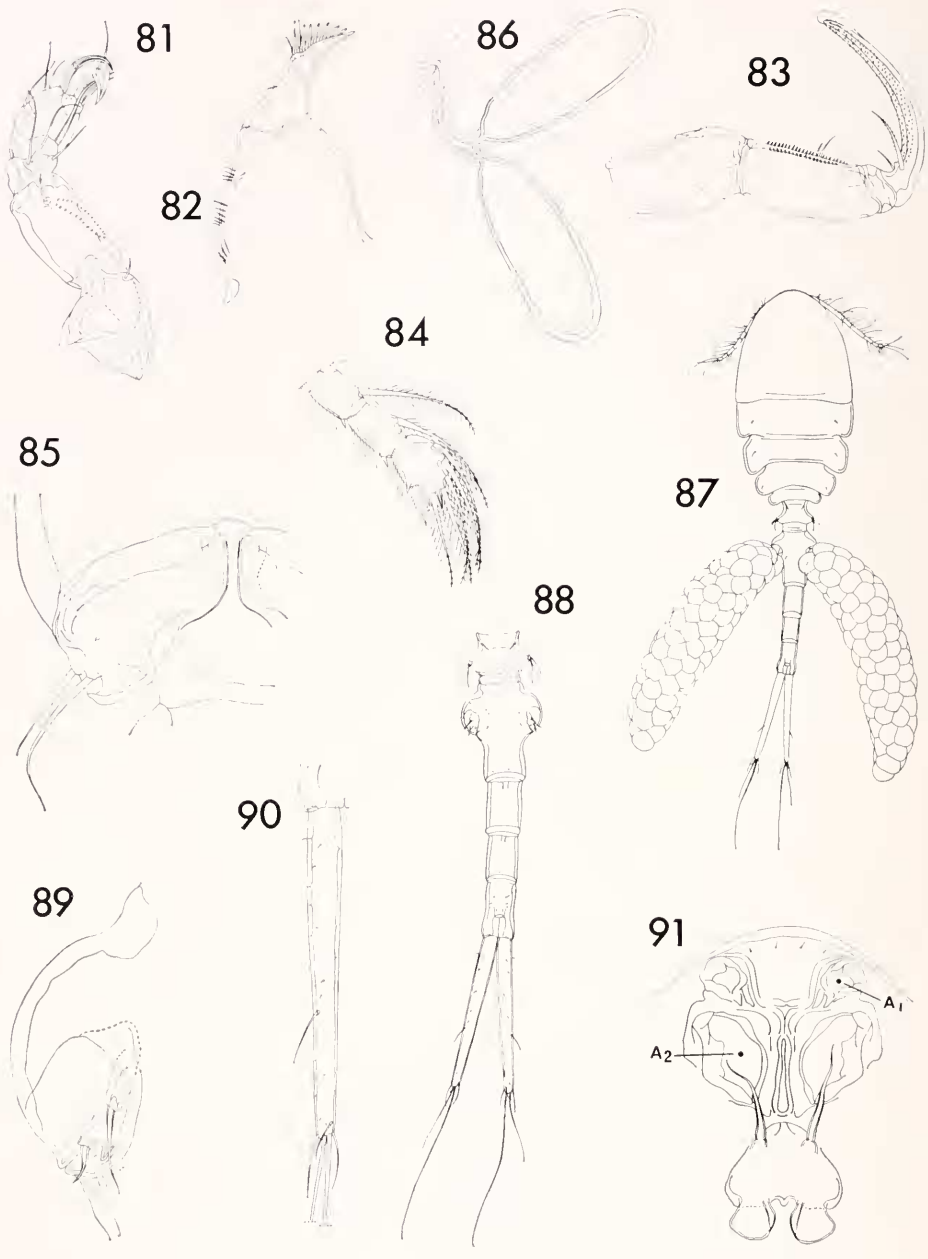


Figures 60–70. *Nasomolgus firmus* n. sp., female. 60, dorsal (H); 61, urosome, dorsal (G); 62, area of attachment of egg sac, dorsal (C); 63, caudal ramus, dorsal (F); 64, egg sac (H); 65, median part of cephalosome, ventral (E); 66, first antenna, ventral (D); 67, second antenna, anterior (C); 68, mandible, ventral (C); 69, paragnath, ventral (I); 70, first maxilla, anteraventral (F).



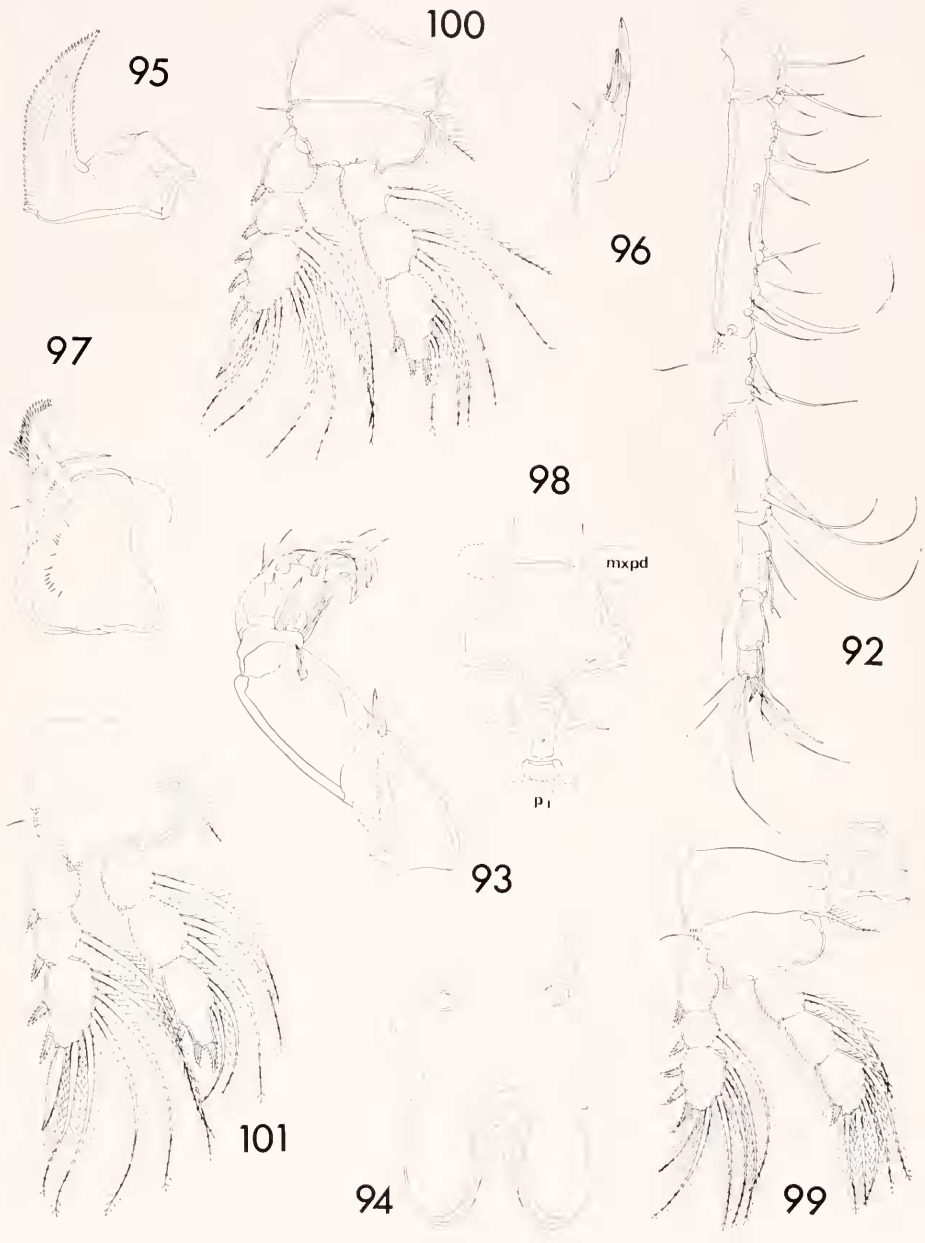
Figures 71–77. *Nasamolgus firmus* n. sp., female (continued). 71, second maxillo, posterodorsal (C); 72, maxilliped, anterior (C); 73, leg 1 and intercoxal plate, anterior (D); 74, leg 2, anterior (D); 75, leg 3, anterior (D); 76, leg 4 and intercoxal plate, anterior (D); 77, leg 5, dorsal (F).

Figures 78–80. *Nasamolgus firmus* n. sp., male. 78, dorsal (B); 79, urosome, dorsal (E); 80, caudal ramus, dorsal (I).

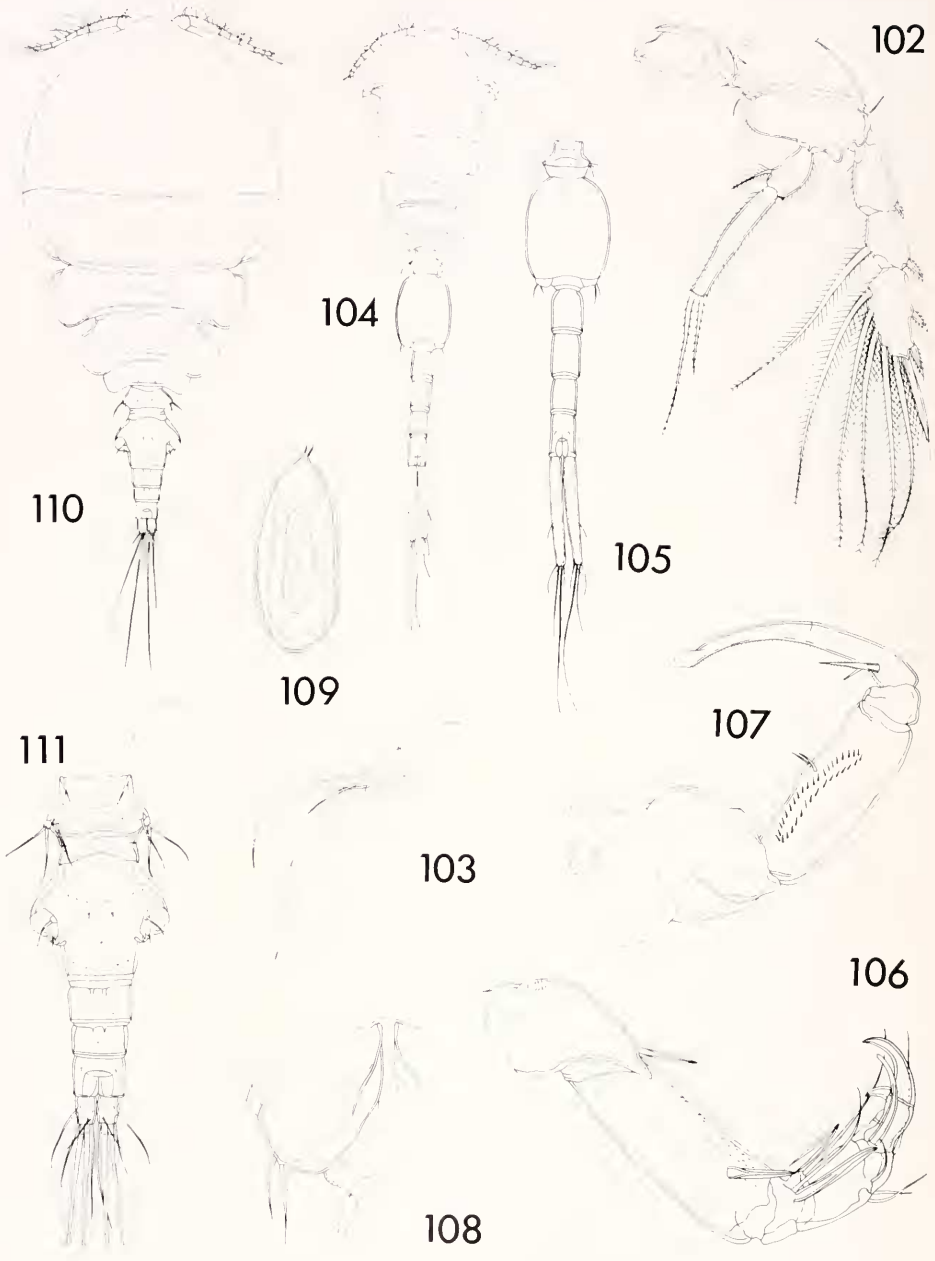


Figures 81–86. *Nasomolgus firmus* n. sp., male (continued). 81, second antenna, inner (C); 82, second maxilla, posterior (F); 83, maxilliped, posteromedial (C); 84, endopod of leg 1, anterior (C); 85, leg 6, ventral (F); 86, spermatophore, attached to female, ventral (D).

Figures 87–91. *Nasomolgus leptus* n. sp., female. 87, dorsal (A); 88, urosome, dorsal (H); 89, area of attachment of egg sac, dorsal (C); 90, caudal ramus, dorsal (G); 91, rostral area and labrum, with labral lobes erected ventrally and thus foreshortened in the drawing, ventral (E).



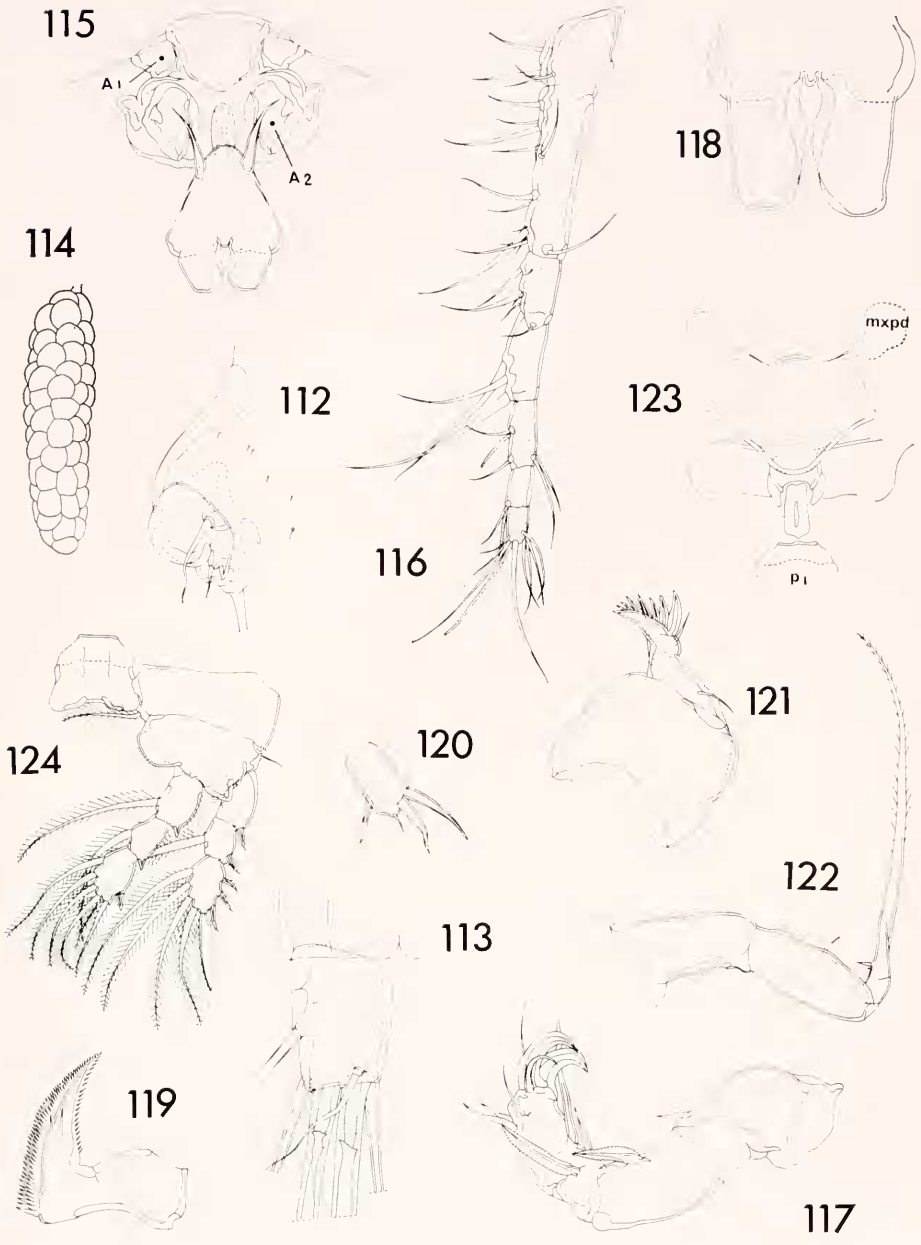
Figures 92–101. *Nasomolgus leptus* n. sp., female (continued). 92, first antenna, dorsal (D); 93, second antenna, posterior (D); 94, posterior part of labrum with bases of two setae, ventral (C); 95, mandible, ventral (C); 96, first maxilla, inner (C); 97, second maxilla, posterodorsal (C); 98, postoral area, ventral (E); 99, leg 1 and intercoxal plate, anterior (E); 100, leg 2, anterior (E); 101, leg 3, anterior (E).



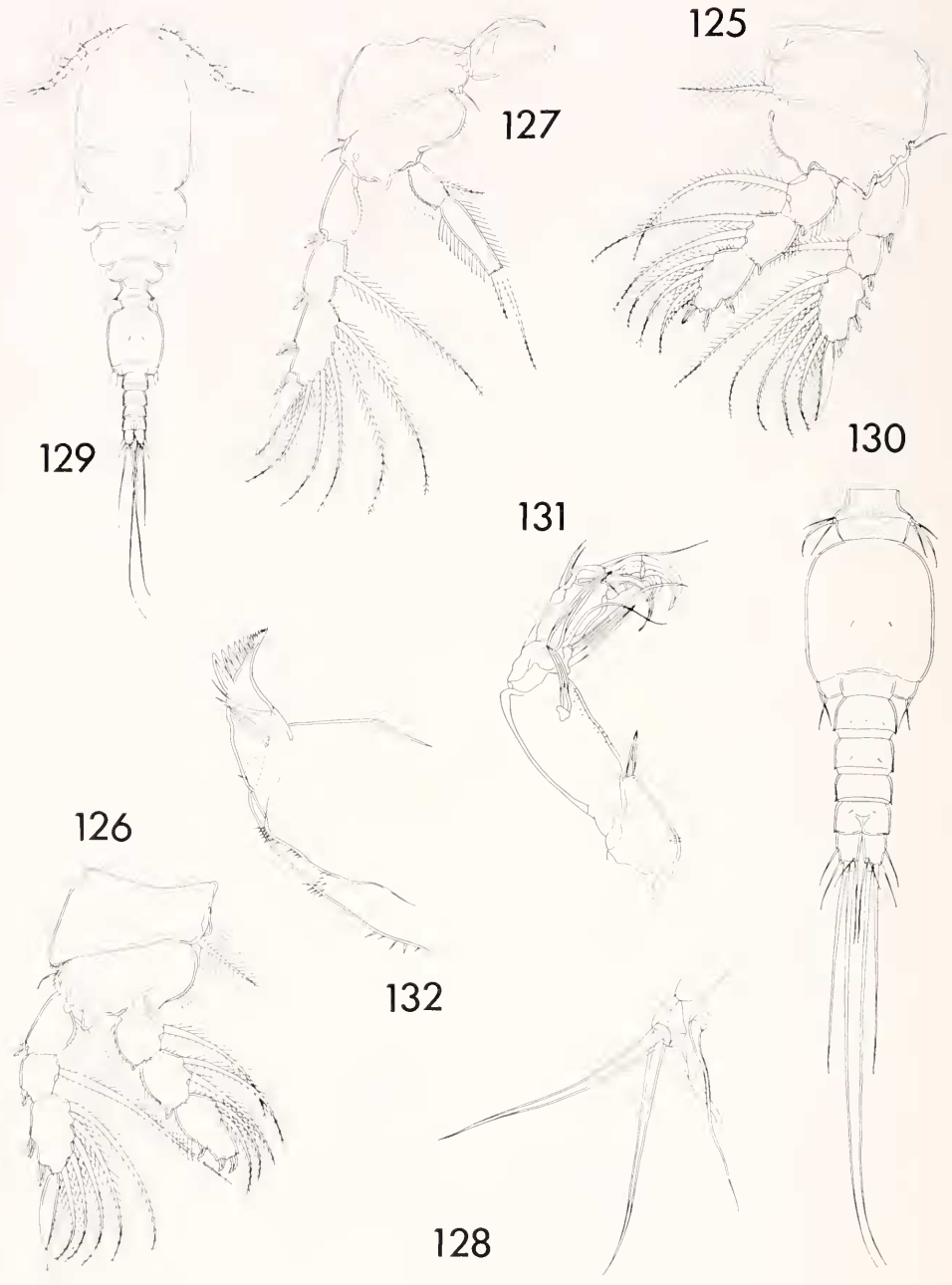
Figures 102–103. *Nasomalgus leptus* n. sp., female (continued). 102, leg 4 and intercoxal plate, anterior (E); 103, leg 5, dorsal (F).

Figures 104–109. *Nasomalgus leptus* n. sp., mole. 104, dorsal (H); 105, urosome, dorsal (B); 106, second antenna, posterior (C); 107, moxilliped, posteromedial (C); 108, leg 6, ventral (C); 109, spermatophore, inside mole, dorsal (E).

Figures 110–111. *Nasomalgus rudis* n. sp., female. 110, dorsal (H); 111, urosome, dorsal (G).

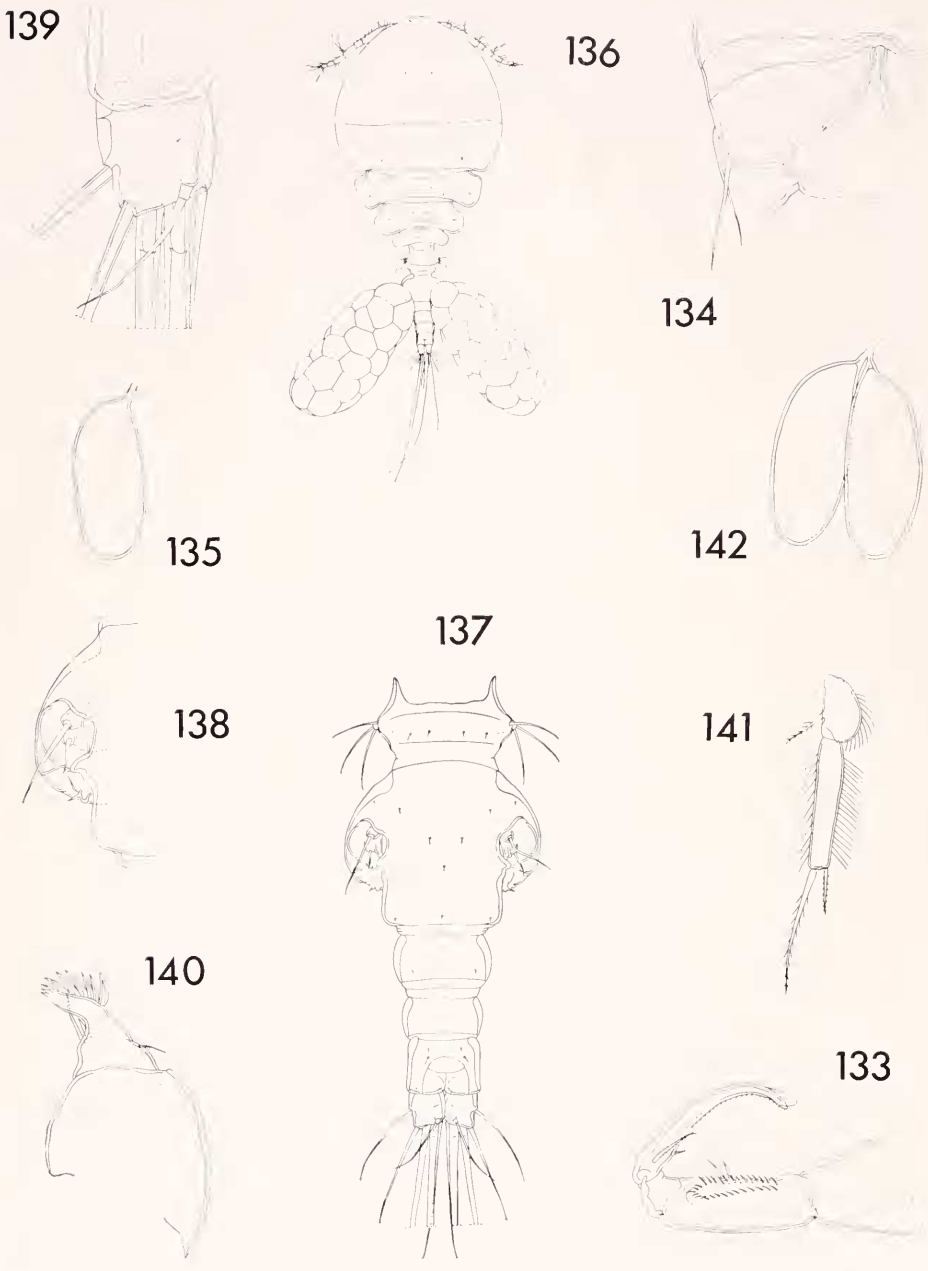


Figures 112–124. *Nasamalgus rudis* n. sp., female (continued). 112, area of attachment of egg sac, dorsal (C); 113, caudal ramus, dorsal (F); 114, egg sac, dorsal (H); 115, rostral area and labrum, with labral lobes erected ventrally and thus foreshortened in the drawing, ventral (E); 116, first antenna, dorsal (D); 117, second antenna, posterior (D); 118, posterior part of labrum, ventral (C); 119, mandible, dorsal (C); 120, first maxilla, ventral (C); 121, second maxilla, posterior (C); 122, maxilliped, posterior (C); 123, postoral area, ventral (E); 124, leg 1 and intercoxal plate, anterior (E).



Figures 125–128. *Nasomolgus rudis* n. sp., female (continued). 125, leg 2, anterior (E); 126, leg 3, anterior (E); 127, leg 4 and intercoxal plate, anterior (E); 128, leg 5, dorsal (F).

Figures 129–132. *Nasomolgus rudis* n. sp., male. 129, dorsal (B); 130, urosome, dorsal (E); 131, second antenno, posterior (C); 132, second moxilla, anterior (I).



Figures 133–135. *Nasamolgus rudis* n. sp., male (continued). 133, maxilliped, posteromedial (C); 134, leg 6, ventral (F); 135, spermatophore, attached to female, dorsal (D).

Figures 136–142. *Nasamolgus parvulus* n. sp., female. 136, dorsal (H); 137, urosome, dorsal (D); 138, area of attachment of egg sac, dorsal (C); 139, caudal ramus, dorsal (I); 140, second maxilla, posterior (F); 141, endopod of leg 4, anterior (C); 142, spermatophores, attached to female, ventral (D).